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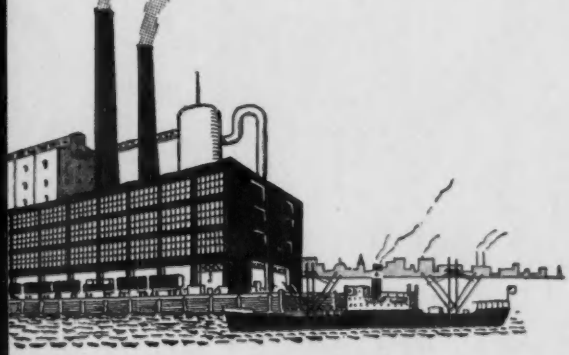

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ECONOMIC GEOGRAPHY

VOL. 37 APRIL, 1961 NO. 2

CHANGES IN THE LOCATION PATTERN OF THE ANGLO-AMERICAN STEEL INDUSTRY: 1948–1959

Gunnar Alexandersson

Dr. Alexandersson, Associate Professor of Economic Geography at the Stockholm School of Economics, is the author of "The Industrial Structure of American Cities: a Geographic Study of Urban Economy in the United States," published in 1956. He carried on the present study during 1959 while he was visiting professor at the University of Wisconsin.

IN empirical studies the location pattern of the iron and steel industry is usually approached through the assembly costs for raw materials at various actual and potential steel centers. This is a reasonable approach as assembly costs for raw materials make up a significant part of total costs for bulky and cheap products like the common types of steel. Most writers also emphasize that transportation costs for the finished product to market are a very important location factor.[1] However, since the freight rate structure for finished products is more varied and complicated than that for raw materials and the flow of steel products from mill to market is more complex than the flow of raw materials from mine to mill, no attempts have been made to evaluate nearness to markets in terms of dollars and cents. The strong pull of the market is a function not only of higher transportation costs for finished products than for raw materials but also of changing buying habits of steel users towards hand-to-mouth buying, especially since the 1930's. About five-sixths of all steel is shipped from mills directly to users, the products often being made to the users' specifications.[2]

[1] Marvin J. Barloon: "Some Problems of Relocation Facing the Steel Industry," *Latin American Studies*, Univ. of Texas, No. 9, 1950, pp. 31–49; and "The Expansion of Blast Furnace Capacity, 1938–1948: A Study in Geographical Cost Differentials," *The Business History Review*, Cambridge, Mass., Vol. 28, March, 1954, pp. 1–23; H. H. Chapman: *The Iron and Steel Industries of the South*, University of Alabama, 1953; Richard Hartshorne: "The Location of the Iron and Steel Industry," *Econ. Geog.*, Vol. 4, 1928, pp. 241–253; Allan Rodgers: "Industrial Inertia, A Major Factor in the Location of the Steel Industry in the United States," *Geogr. Rev.*, Vol. 42, 1952, pp. 56–66; and "The Iron and Steel Industry of the Mahoning and Shenango Valleys," *Econ. Geog.*, Vol. 28, 1952, pp. 331–342; C. Langdon White: "Geography's Part in the Plant Cost of Iron and Steel Production at Pittsburgh, Chicago and Birmingham," *Econ. Geog.*, Vol. 5, 1929, pp. 327–335; C. L. White and G. Primmer: "The Iron and Steel Industry of Duluth: A Study in Locational Maladjustment," *Geogr. Rev.*, Vol. 27, 1937, pp. 82–91; Chauncy D. Harris: "The Market as a Factor in the Localization of Industry in the United States," *Annals of the Assn. Amer. Geogrs.*, Vol. 44, 1954, pp. 315–348; Arthur H. Doerr: "A Quantitative Analysis of the Locational Factors in the Integrated and Semi-integrated Iron and Steel Industry of the United States and Canada," *Journ. of Geog.*, Vol. 53, 1954, pp. 393–402.

[2] Douglas A. Fisher: *Steel Serves the Nation. The Fifty Year Story of United States Steel*, New York, 1951, p. 217.

Attempts have been made to forecast future changes in the location pattern of the iron and steel industry, based upon anticipated changes in assembly costs for raw materials, changes in the market for steel products, etc.[3] Some factors of importance for the location pattern have been considered and attempts have been made to quantify their influence. It has, of course, not been possible to take into account all influencing factors. So far no attempts have been made to present "the future locational pattern" of the American steel industry in map form.

[3] Cf. Walter Isard and William M. Capron: "The Future Locational Pattern of Iron and Steel Production in the United States," *Journ. of Polit. Econ.*, Vol. 57, 1949, pp. 118–133.

[4] Such a study may of course provide clues for forecasts of future changes in the distribution pattern of the Anglo-American steel industry: the time-honored method of extrapolating past trends into the future. This method could easily be applied to a detailed forecast in map form. In this period of revolutionary innovations in the steel industry the extrapolation method, however, should be used with greater circumspection than ever. Competition from other materials (aluminum, cement, glass, plastics, etc.) makes it hazardous even to forecast the total production of steel in, say, 1970.

Other factors also call for caution. Example: A vigorous and ingenious management has in the past played an important role in the expansion of individual steel companies and steel centers. It is impossible to forecast where such extraordinary personal endeavors will be made. For the 1948–1959 period Kaiser Steel, Detroit Steel, and Granite City Steel, the fastest growing of the 20 leading steel companies, all with growth rates exceeding 100 per cent, may be mentioned as examples. The fact that these three corporations with their widely different locations were the first to sign an agreement with the union after the long steel strike in 1959 is indicative of a vigorous management which the growth rate in itself suggests.

Recent changes in the distribution pattern of the Anglo-American steel industry should be of interest also to augurs dealing with the future European pattern. The same economic forces should be at work in both cases. The impact of two devastating wars and a depression and the compartmentalization of Europe into small national markets makes it reasonable to assume that the European pattern lags a few decades behind the Anglo-American. With a closer economic co-operation in Europe the European steel industry may start to catch up with the Anglo-American development and form a pattern more in agreement with its North American counterpart.

In this study a less ambitious goal is set. The goal is simply to observe, from the vantage point of the *ex post* situation, how the location pattern of the steel industry has changed in the last decade and to see if it is possible to arrive at some generalizations about the changes.[4] Since the national pattern is the sum of patterns for a small number of large companies with a large number of small companies just filling in and complementing the general pattern, it has seemed reasonable to approach the problem from an individual company basis. The companies are the decision making units, and their decisions are based on careful investigations, including a mass of data of which only part is presumably known to the general public.

It is probably unnecessary to point out that the differences in growth rates of companies observed in this study do not necessarily indicate differences in business success; that is measured by profits and not by growth rates. It should also be remembered that all large companies are more or less integrated vertically. Their activity may stretch from the iron and coal mines and limestone quarries all the way through transportation facilities, blast furnaces, coke ovens, steel mills (the only thing studied here), and finishing mills, to scattered warehouses supplying small steel users with products weighed in pounds. In the 1948–1959 period some companies may have emphasized the acquisition of raw material sources in their investment programs or they may have built up their finishing facilities proportionately more than their steel capacity. Two companies with the same "total" growth rates may thus have different expansion rates for their ingot capacity.

FIGURES 1 AND 2

The present study is focused on two maps, Figures 1 and 2, based on capacity

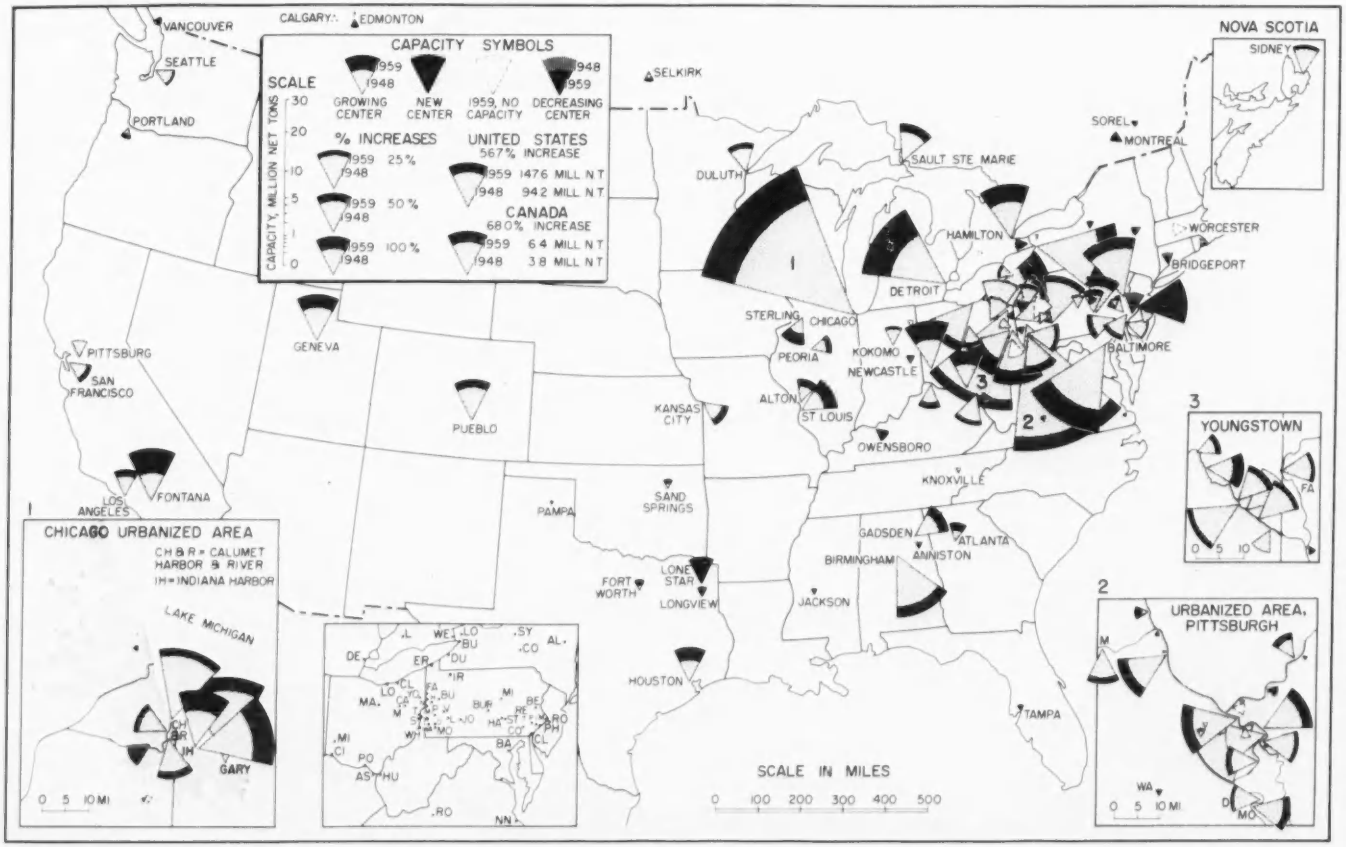

FIG. 1. Raw steel capacity in Anglo-America, 1948 and 1959.

data published annually by the American Iron and Steel Institute.[5] The same symbols, circle sectors with constant angles in which the surface is proportionate to quantities shown, were used by the author several years ago on three maps showing the oil refining centers of the world.[6] In the present study a new element, change, is introduced on the symbols, which makes them more complicated and difficult to interpret. The chief purpose is the same: to present the distribution pattern of an urban industry on a map scale that will permit a world-wide treatment of the industry on a few book pages without leaving out any production center. Even the small centers are part of the pattern, sometimes an important and always an interesting part, and should not be left out.[7]

With these ends in mind it is obviously not possible to use circles or squares as symbols. Sectors are superior to full circles, where either is possible to apply, in one important respect: they give a better indication of location by not covering so much of state boundaries, shore lines, and other orientation marks. In another respect they are inferior: they give a less harmonious picture. On Figure 1 Pennsylvania and Ohio are crowded with symbols, but each of them can be identified with the help of an inset map. (The full names are given in Table I.) If necessary it would have been possible to squeeze in even more symbols by choosing a more acute angle or by using different map scales for eastern and western United States and an inset for Ohio-Pennsylvania.[8]

The symbol scale is the same on Figures 1 and 2. As shown in the legend of Figure 1, a growing steel center, the normal case, is represented by the dotted symbol for 1948 superimposed on the black 1959 symbol. The black margin thus represents increase in capacity. New steel centers which did not exist in 1948 have only the 1959 symbol. Centers which have disappeared from the map since 1948 are shown with a white sector. Those with unchanged capacity are represented by a 1948 symbol (a few centers with only a slight decrease were also shown this way). The symbol for decreasing centers is shown in the legend. On three inset maps are shown the location of individual plants in the leading steel centers: Chicago, Pittsburgh, and Youngstown. The term "center" refers to the urbanized area, which on the inset map is stippled. The Pittsburgh map includes four plants outside the urbanized area and the Youngstown map, two. Figure 1 should be compared with Table I in which the steel centers are grouped into *areas*.[9]

Figure 2 shows the individual plants of the eight largest steel companies in the United States, with 76.8 per cent of

[5] *Directory of Iron and Steel Works of the United States and Canada 1948*, American Iron and Steel Institute, New York, 1948; *Annual Capacities of Coke Ovens, Blast Furnaces and Steelmaking Furnaces as of January 1, 1959, by Companies and States (United States and Canada)*, American Iron and Steel Institute, New York, 1959.

[6] Gunnar Alexandersson: "The Oil Refineries of the World—A Case Study," *Proceedings of IGU Regional Conference in Japan, 1957*, Tokyo, 1959.

[7] Both the refinery paper and the present study stem from the author's opinion that economic geographers, including textbook writers, do not give to urban industries a quantitative treatment which is on a par with the presentation of agriculture (crops) and mining.

[8] The latter solution was chosen by Gochman on his map of the American steel industry. See V. M. Gochman: *Geografija T'ažoloj Promyšlennosti SŠA*, Moskva, 1956, p. 139.

[9] A small, new steel mill (60,000 tons capacity) at Phoenix, Arizona, was not included on the maps as it could not be located at the time when the maps were drawn. It was listed under Helena, Arizona, which could not be found on any map and was unknown to the post offices of the state. According to a letter from the Phoenix Chamber of Commerce it is located at Tempe, a suburb of Phoenix.

TABLE 1

STEEL CENTERS ARRANGED BY AREAS

Areas and centers	*CAPACITY* *Thousand net tons*		*Increase 1948–1959*	*Percentage increase 1948–1959*
	1948	*1959*		
I. COAL VALLEYS OF THE APPALACHIAN AREA				
A. *Pittsburgh* (P; PI)	14,734	18,345	3,611	24.5
B. *Other centers along the Ohio, Monongahela, and Allegheny Rivers*	8,368	13,218	4,850	58.0
Monessen (MO)	1,072	1,560	488	45.5
Donora (D; DO)	842	1,015	173	20.5
Midland (M)	998	1,362	364	36.5
Toronto (T)	136	136	0	0.0
Weirton (W; WE)	1,950	3,300	1,350	69.2
Steubenville (S)	1,073	2,400	1,327	123.7
Wheeling (WH)	336	.....	−336	−100.0
Huntington (HU)	.....	110	110	new
Ashland (AS)	828	1,022	194	23.4
Portsmouth (PO)	720	1,500	780	108.3
Cincinnati-Newport (CI)	413	613	217	52.5
Owensboro	.....	183	183	new
C. *Other centers in western Pennsylvania*	4,184	4,612	428	10.2
Johnstown (JO; J)	1,924	2,425	501	26.0
Latrobe (L)	103	145	42	40.8
Farrell (FA)	1,000	1,268	268	26.8
Harmony (H)	150	90	−60	−40.0
Irvine (IR)	25	25	0	0.0
Vandergrift (V)	500	.....	−500	−100.0
Washington (WA)	50	36	−14	−28.0
New Castle (N)	.....	66	66	new
Butler (BU)	432	557	125	28.9
D. *Other centers in eastern Ohio*	11,274	13,664	2,390	21.2
Youngstown (YO)	8,932	11,155	2,223	24.9
Massillon (M)	610	680	70	11.5
Canton (CA; C)	1,732	1,829	97	5.6
E. *Southern Appalachian district*	3,634	5,421	1,787	49.2
Birmingham	2,910	4,178	1,268	43.6
Gadsden	650	1,209	559	86.0
Anniston	74	34	−40	−54.1
II. SOUTHERN SHORES OF THE GREAT LAKES	29,490	50,512	21,022	71.3
Chicago	17,420	26,970	9,550	54.8
Detroit	3,473	7,942	4,469	128.7
Lorain (LO)	1,884	2,648	764	40.6
Cleveland (CL)	2,340	5,435	3,095	132.3
Erie (ER)	209	284	75	35.9
Dunkirk (DU)	33	33	0	0.6
Buffalo (BU)	4,131	7,200	3,069	74.3
III. ATLANTIC SEABOARD AND ADJACENT AREA				
A. *Atlantic Seaboard*	6,264	12,176	5,912	94.4
Newport News (NN)	8	15	7	87.5
Baltimore	4,746	8,382	3,636	76.6
Claymont (CL)	460	507	47	10.2
Philadelphia (PH)	549	173	−376	−68.5
Roebling (RO)	253	235	−18	−7.1
Morrisville (M; MO)	.....	2,687	2,687	new
Bridgeport	188	84	−104	−55.3
Phillipsdale, Rh.I.	60	93	33	55.0
B. *Inland centers, eastern Pennsylvania*	5,489	8,445	2,956	53.9
Harrisburg (HA)	389	588	199	51.2
Steelton (ST)	886	1,500	614	69.3
Milton (MI)	.....	90	90	new
Lewistown (Burnham, BUR)	149	189	40	26.8
Reading (RE)	75	88	13	17.3
Coatesville (CO)	624	930	306	49.0
Bethlehem (BE)	2,585	3,900	1,315	50.9
Phoenixville (P)	231	360	129	55.8
Conshohocken (Ivy Rock, I)	550	800	250	45.5
C. *Inland Centers, New England and New York*	403	192	−211	−52.4
Worcester	250	.....	−250	−100.0
Albany-Troy (AL, Watervliet)	25	77	52	208.0
Cortland (CO)	38	32	−6	−15.8
Syracuse (SY)	68	61	−7	−10.4
Lockport (LO)	22	22	0	0.0

TABLE I (*continued*)

STEEL CENTERS ARRANGED BY AREAS

Areas and centers	*CAPACITY* Thousand net tons		*Increase 1948–1959*	*Percentage increase 1948–1959*
	1948	*1959*		
IV. INLAND CENTERS, EASTERN OHIO, INDIANA, AND ILLINOIS	3,337	6,919	3,582	107.3
Mansfield (MA)	370	500	130	35.1
Middletown (MI)	972	2,557	1,585	163.1
Fort Wayne	38	38	0	0.0
Kokomo	364	420	56	15.4
New Castle	24	64	40	166.7
St. Louis (Granite City)	620	1,440	820	132.3
Alton	326	600	274	84.0
Peoria	302	475	173	57.3
Sterling	321	825	504	157.0
V. LAKE SUPERIOR ORE PORTS				
Duluth	690	973	283	41.0
VI. THE SOUTH, OUTSIDE OF THE APPALACHIAN COAL FIELDS	839	3,027	2,188	260.8
Tampa	.....	43	43	new
Atlanta	165	400	235	142.4
Knoxville	38	38	0	0.0
Roanoke (RO)	.....	25	25	new
Jackson (Flowood)	.....	45	45	new
Sand Springs	54	120	66	122.2
Longview	.....	90	90	new
Lone Star	.....	800	800	new
Fort Worth	22	132	110	500.0
Houston	560	1,343	783	139.8
Pampa	.....	16	16	new
VII. THE WEST				
A. *Large coastal cities*	2,516	5,234	2,718	108.0
Fontana	870	2,933	2,063	237.1
Los Angeles	463	801	338	73.0
Pittsburg	363	380	17	4.7
San Francisco	407	569	162	39.8
Portland	66	150	84	127.3
Seattle	347	401	54	15.6
B. *Inland centers*	2,981	4,868	1,887	63.3
Geneva	1,283	2,300	1,017	79.3
Pueblo	1,272	1,800	528	41.5
Phoenix, Arizona	.....	60	60	new
Kansas City	426	708	282	66.2
UNITED STATES, TOTAL	94,203	147,634	53,431	56.7

the total capacity.[10] All plants of the remaining 74 companies are shown in the lower right corner of Figure 2. For the two leading steel companies the growth rate of individual plants and steel centers are compared with national and company rates (inset diagrams).

COMMENTS ON FIGURES 1 AND 2

Some generalizations can be based on Figures 1 and 2:

1. *Changes in the location pattern of the Anglo-American steel industry were caused almost entirely by differences in growth rate among existing steel centers and steel plants.* Almost all steel plants expanded their capacity. Few new plants were added and few plants were closed down. The eight largest corporations, with 76.8 per cent of the American capacity in 1959, built only one new plant and closed down only two. The other 51 mills expanded or had unchanged capacity. The small steel corporations added some new plants, most of them very small, scrap-

[10] The new Jones & Laughlin mill in Detroit is identical with the "disappeared" plant on the map in the lower right corner according to a letter from the Detroit Chamber of Commerce. The only new steel mill built by the eight big companies is the Morrisville plant of the U. S. Steel.

based electric-furnace-mills owned by local one-plant corporations.

2. The 1948–1959 period saw a steady increase in the size of American steel mills. *In a period of rapid expansion of the national steel capacity steel plants continue to grow in almost any location.* The rationale behind this fact seems to be the following: (a) The needed investment per ton of annual steel capacity may be as much as four times higher for a new plant on an undeveloped site than for the same capacity added to existing facilities.[11] (b) Multiplant corporations for technical-economic reasons usually have a division of labor between their plants; the plants to a certain degree specialize on different types of products. This may prevent restriction of the corporation's expansion to a single new mill in the most favorable location. (c) The policy of not putting all eggs in the same basket may also contribute to a spreading of a corporation's expansion to all its plants instead of a concentration in an optimum-located new plant. This may make the company better prepared to meet seasonal, cyclical, and long-term structural changes in the demand for steel, changes which may have geographical implications.[12]

A steel center with an obsolete location as far as transportation costs are concerned usually has compensating assets such as experienced labor and a community with schools, banks, and other service facilities geared to the steel industry. It has, of course, buildings and machinery which may not be useful for any other purpose. The influence of these and other factors, which are difficult to measure, is often referred to as inertia. Inertia is a strong force working on all industrial location patterns.

3. *Steel mills with a coastal location had high growth rates.* Remarkably high rates of increase were noted for the following large steel centers: Chicago, Detroit, Cleveland, and Buffalo, all million-cities on the Great Lakes; Hamilton, the leading Canadian steel center; and Baltimore. Common characteristics of these centers are their coastal location, with consequent low transportation costs for iron ore and in some cases also for other raw materials (limestone, coal, and scrap), and their favorable market situation. Chicago, Detroit, and Cleveland rank among the leading North American metal manufacturing centers; Buffalo has a strategic location between the Lower Lakes market and the East Coast, especially New York City, which is the largest American steel market having no local steel capacity; Hamilton has a central location in the Canadian part of the Manufacturing Belt. The U. S. Steel's Morrisville plant, located on the Delaware River between Philadelphia and New York, one of the two large American mills built in the 1950's, also is a coastal mill with a good market location. Chicago, the world's largest steel center, with a capacity (27.0 million tons) exceeding that of the United Kingdom (26.2 million tons) and France (17.9 million tons) and approaching that of West Germany (30.9 million tons),[13] had a growth rate almost equal to the national average (Fig. 3). It grew more than twice as fast as the second and third largest American steel centers, Pittsburgh and Youngstown.

[11] W. B. Boyer: "Problems of Financing New Steel Capacity," *Iron and Steel Engineer*, Vol. 34, 1957, pp. 75–76; see also "The Siting of British Steelworks," *Steel Review*, July, 1958, pp. 26–35.

[12] The automotive industry in southern Michigan may work at a peak when the construction industry in New York City is in the doldrums and vice versa. This example illustrates both seasonal and cyclical changes. Structural changes, which may or may not be associated with geographic shifts, occur all the time. The switch in demand from locomotives and railroad cars to autos and trucks—produced in different cities—is just one example.

[13] *Steel Facts*, No. 153, February, 1959, p. 4.

4. *In the United States more than half of the steel capacity (54.3 per cent) is located in the outskirts of million cities:* Chicago, Pittsburgh, Detroit, Cleveland, Buffalo, Baltimore, Philadelphia, St. Louis, Los Angeles, and San Francisco. Only New York, Boston, Washington, and Minneapolis–St. Paul lack basic steel industries. Of these cities, New York, with an excellent location for integrated steel mills, is a notable exception to the observation that big cities have attracted a very substantial steel capacity.[14] Pittsburgh is the only example of a million-city having reached its size primarily because of its steel industry (which in turn has attracted metal manufacturing industries). It is the only city located close to either coal or iron ore.

The American million-cities increased their capacity somewhat faster than the national average[15] (61.2 and 56.7 per cent respectively), but the growth rate varied considerably from city to city (Table I).

By way of comparison, it may be mentioned that the steel industries of Western Europe and the Soviet Union still are overwhelmingly concentrated near coal, primarily, and iron ore fields, a location which has been "obsolete" in the United States for several decades, as indicated by lower growth rates for such centers (see Pittsburgh, Youngstown, and others).

5. *Even the largest American steel corporations are solidly planted in a limited region, the district from which they originated.* The world's largest free trade area is their market, but they have only to a limited extent ventured new producing facilities outside of the region where they were formed a few decades ago through mergers of many small companies. Bethlehem Steel has almost all its capacity at five steel centers within a small region in the eastern part of the Manufacturing Belt. U. S. Steel has 59 per cent of its capacity in two centers, Chicago and Pittsburgh, and 75 per cent in the Chicago-to-Pittsburgh region. There is a remarkably neat separation of location patterns between these two steel giants, of which U. S. Steel undoubtedly has had the best general location with the westward movement of the center of population and the center of steel manufacturing industries. For location patterns of these and other large companies, see Figure 2. It shows Bethlehem Steel by itself in the eastern part of the Manufacturing Belt and U. S. Steel competing in the central and western part of the Belt with the six companies that follow these in size.

All these patterns have run through the same development: merging of many small companies and their numerous mills, concentration of production in a few of the best located plants, expansion of capacity by additions to existing facilities. Plans to extend production into new areas have, when they have materialized, usually led to the acquisition of already established companies. The cases when big corporations have built new facilities outside of their "home areas" are rare, indeed. The possibilities for the largest companies to round off their location patterns by acquiring existing companies are hampered by institutional factors, as shown in 1958 when the overtures for a merger between Bethlehem Steel and Youngstown Sheet & Tube were stopped by the federal antitrust agency.

6. *There were great differences in expansion rates among the eight largest steel corporations.* U. S. Steel, the world's

[14] Lack of suitable sites? Are reasonably-priced tracts of land on tidewater and with large supplies of water for cooling purposes available in the New York area?

[15] Fontana was included in Los Angeles, but Morrisville was not included in Philadelphia in these calculations.

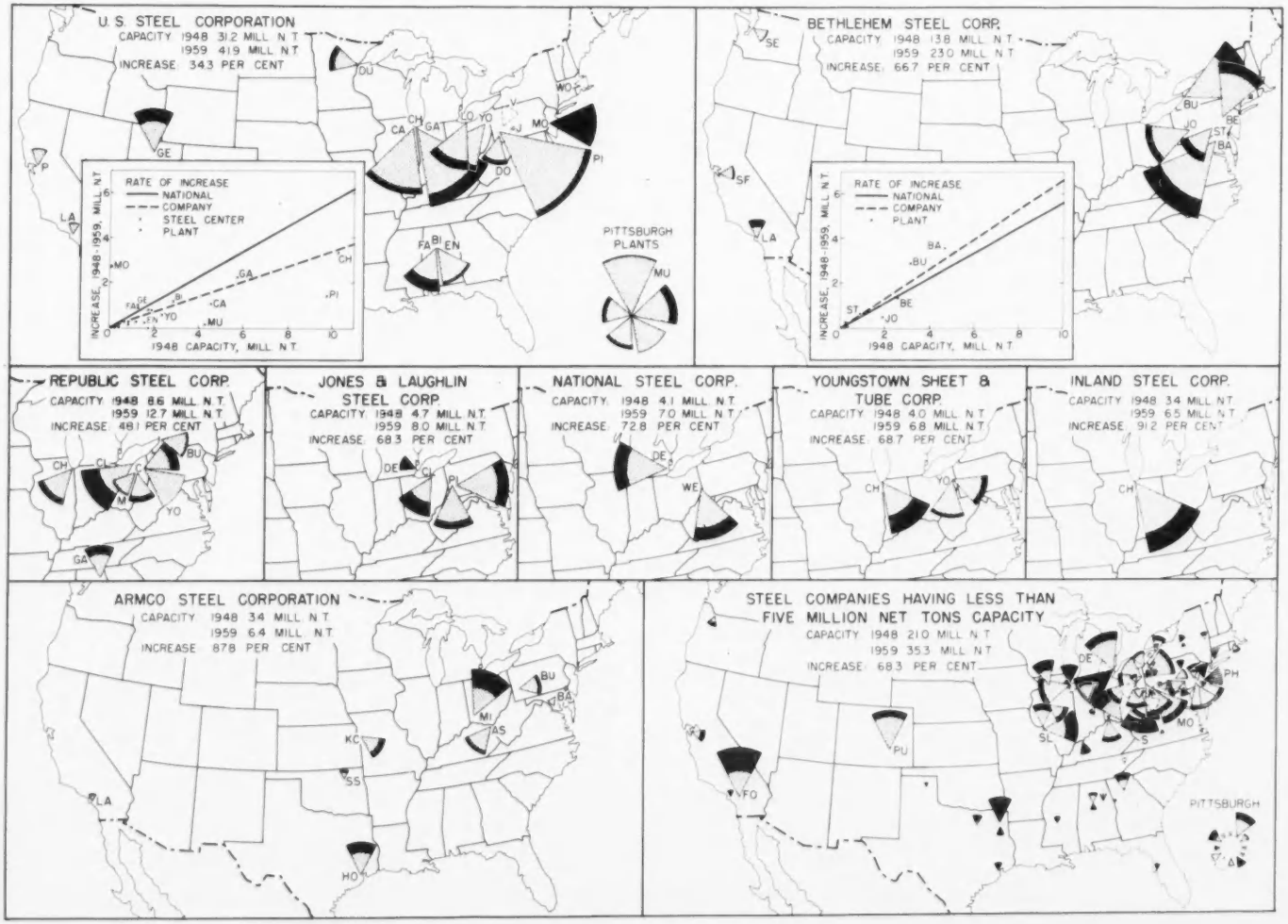

FIG. 2. Steel plant locations in the United States by individual companies, 1948 and 1959.

leading steel company, had a conspicuously low rate of increase. Six of the eight largest steel corporations in the United States expanded faster than the national average (Fig. 2).

7. *Both slow-growing and fast-growing multi-plant corporations had, with few exceptions, a higher expansion rate in fast-growing centers than in slow-growing centers.* The attractiveness of coastal-market locations at the million-cities on the Great Lakes and the Atlantic Seaboard was thus recognized by most of the large multi-plant corporations. This "recognition" materialized, however, in only one new plant (Morrisville). Other companies did not go so far. National Steel, for instance, has acquired plant sites in New Jersey and at Chicago and Bethlehem Steel owns one in the Chicago area, but no plants have yet been built on these sites.

8. *A steel center dominated by a slowly growing corporation may have a higher expansion rate than the company and still grow more slowly than the national average.* A case in point is Birmingham, dominated by the two U. S. Steel plants, Fairfield and Ensley. The former was second only to Geneva in expansion rate among the corporation's plants (see map and diagram, Fig. 2), giving an above-company growth rate to Birmingham. This was, however, not sufficient to match the national average. The example points up the necessity for taking corporation policy into account when various steel centers are evaluated. It is not sufficient to consider location only with regard to raw materials and markets.

REGIONAL VARIATIONS IN GROWTH RATE

In Table I the American steel centers have been arranged in districts or areas according to the principle that centers with similar location in respect to raw material supply and markets should be grouped together. Location as regards waterways for the transportation of iron ore, limestone, and coal, as well as finished products, was considered to be more significant than the general geographic location. Thus Monessen and Johnstown, both located in western Pennsylvania, were referred to different areas, whereas Monessen and Owensboro, separated by much larger distances, were grouped together because they are both on the Ohio River system, which serves as a cheap transportation route. An attempt was made to make the names of the districts self-explanatory and thus imply the underlying principle for the division.

The Anglo-American steel industry is strongly concentrated in the Manufacturing Belt, stretching from the Atlantic Seaboard (southern Maine-Baltimore) to the Middle West (Milwaukee–St. Louis) and including a narrow Canadian strip along the St. Lawrence River and the northern shores of Lake Ontario and Lake Erie from Quebec to Windsor. The United States part of this region contains 86.8 per cent of the national steel capacity (1959). In Canada the corresponding share is smaller, 56.3 per cent.

The Manufacturing Belt of the United States had a somewhat lower growth rate than the national average (53 and 57 per cent), that of Canada a higher rate (94 and 68 per cent). Within the American Manufacturing Belt there were interesting regional differences. The Atlantic Seaboard and the Southern Shores of the Great Lakes had considerably higher growth rates than the national average. The "migration" of steel capacity to the latter area has been going on since the end of the last century. The Lake Shores now have more than one-third of the American steel capacity. The Atlantic Seaboard, with

less than one-fourth as much capacity as the latter region, has grown rapidly in the postwar period with an increasing American dependence on imported ores. As is well known, new plants get much more publicity than additions of the same capacity to existing facilities. The widely published establishment of the large plant at Morrisville in the early 1950's may have left foreign observers with a wrong impression of the true importance of the Atlantic Seaboard area on the American steel map. The expansion at Baltimore (Sparrow's Point) actually represents a larger tonnage than the new plant at Morrisville.

The fastest growing area in the Manufacturing Belt, the only one to more than double its capacity, was the inland area from eastern Ohio to western Illinois.[16] This was in sharp contrast to the development in other inland areas of the Manufacturing Belt, especially in the old districts of western Pennsylvania and eastern Ohio, which grew at very low rates. The inland centers of eastern Pennsylvania, even older as a steel district than western Pennsylvania and Ohio, kept their position fairly well with a growth rate close to the one of the Manufacturing Belt as a whole. The small capacity in inland New York State and New England was considerably reduced between 1948 and 1959.

If all steel centers along the Ohio River system outside of Pittsburgh are grouped together they form a district with a larger capacity than the Atlantic

[16] St. Louis is located on the Mississippi, but it receives its ores by rail from southeastern Minnesota and the Lake Superior area. Most of the coal also arrives by rail, but some of the finished products are shipped by barge.

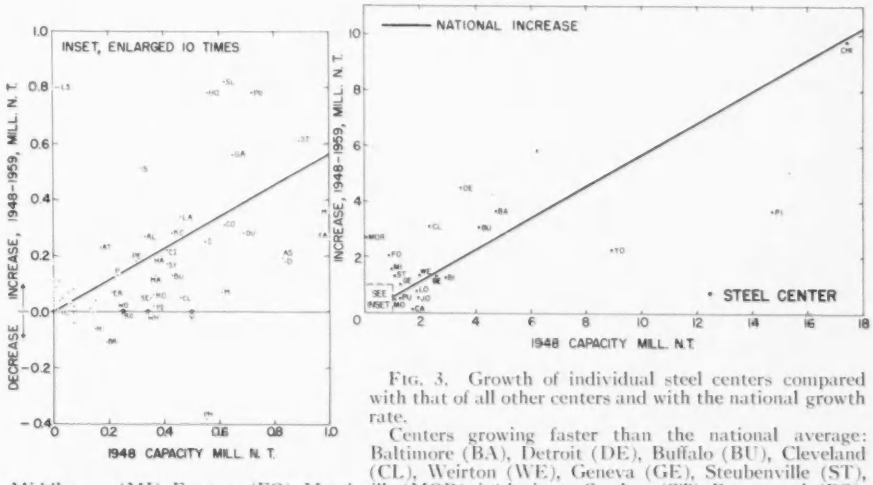
INSET, ENLARGED 10 TIMES
DECREASE INCREASE, 1948-1959, MILL. N. T.
1948 CAPACITY MILL. N. T.
NATIONAL INCREASE
INCREASE, 1948-1959, MILL. N. T.
STEEL CENTER
1948 CAPACITY MILL. N.T.

FIG. 3. Growth of individual steel centers compared with that of all other centers and with the national growth rate.

Centers growing faster than the national average: Baltimore (BA), Detroit (DE), Buffalo (BU), Cleveland (CL), Weirton (WE), Geneva (GE), Steubenville (ST), Middletown (MI), Fontana (FO), Morrisville (MOR); in the inset: Steelton (ST), Portsmouth (PO), St. Louis (SL), Houston (HO), Gadsden (GA), Sterling (S), Los Angeles (LA), Kansas City (KC), Alton (AL), Peoria (PE), Atlanta (AT), and Lone Star (LS).

Centers growing slower than the national average: Chicago (CHI), Pittsburgh (PI), Youngstown (YO), Birmingham (BI), Bethlehem (BE), Lorain (LO), Johnstown (JO), Canton (CA), Pueblo (PU), Monessen (MO); in the inset: Midland (M), Farrell (FA), Ashland (AS), Donora (D), Duluth (DU), Coatesville (CO), Conshohocken (I), Massillon (M), Claymont (CL), Butler (BU), San Francisco (SF), Cincinnati (CI), Harrisburg (HA), Mansfield (MA), Kokomo (KO), Pittsburg (PI), Seattle (SE), Erie (ER), and Phoenixville (P).

Centers which have disappeared in the 1948–1959 period (inset, dot and circle): Vandergrift (V), Wheeling (WH), and Worcester (WO).

Decreasing centers (inset): Philadelphia (PH), Bridgeport (BR), Harmony (H), and Roebling (RO).

Seaboard and with a somewhat higher growth rate than the national average. They grew more than twice as fast as Pittsburgh. The favorable development of the steel industry in the Ohio Valley outside of Pittsburgh paralleled a general expansion of construction work and manufacturing in this river system and to the south of it in the TVA region.

The largest steel district outside of the Manufacturing Belt, the southern Appalachian area, had a somewhat lower expansion rate than the national average, due chiefly to the dominance in this district of the slow-growing U. S. Steel Corporation. Duluth, the only American steel mill near the large ore deposits at Lake Superior, falls into the same category: it experienced an above-company but below national average expansion rate.

The highest growth rate for any of the areas in Table I was recorded for the scattered steel mills of the South outside of the iron ore and coal fields in Alabama. This part of the South has two medium-sized, integrated mills at Houston and Lone Star. The Houston plant was constructed during World War II by Armco with a government loan and based chiefly on scrap;[17] the Lone Star mill, based on local iron ore and coal from Oklahoma, was conceived and built during the last years of World War II as an emergency source of iron for the war effort. Never operated until purchased by a private company in 1948, it became an integrated steel mill in the early 1950's.[18]

The only integrated steel mill west of the Mississippi-Missouri before World War II was the plant at Pueblo. The Geneva and Fontana mills were built during the war, the former by the government and the latter by Kaiser with a government loan. Both were built to supply the shipyards on the West Coast; they relieved the already overburdened transcontinental railroads which had to carry goods normally shipped through the Panama Canal, a route seriously hampered by shortage of tonnage and by enemy submarine attacks. The Geneva and Fontana plants, which might never have been built in peace time with a normal competitive situation, have expanded very rapidly in the postwar period. Geneva had the highest growth rate of any of the U. S. Steel plants (map and diagram of Fig. 2), and Fontana was the fastest growing major plant in the country (Fig. 2).

[17] Elmer H. Johnson: *The Industrial Potential of Texas*, Bureau of Business Research, The University of Texas. No date.

[18] *Facts Concerning Lone Star Steel Company*, Pamphlet, no date; Letter from Mr. Hal Kennedy, Director, Plant Public Relations, Lone Star Steel Company.

THE LEADING AMERICAN STEEL CORPORATIONS

Twenty American steel corporations with more than one million net tons ingot capacity account for 91.1 per cent of the national capacity. The remaining 8.9 per cent is divided among 62 companies.

The mills of the eight largest corporations, accounting for 76.8 per cent of the national capacity, are shown on individual maps (Fig. 2). The plants of the other 12 companies with more than one million tons capacity are easily discernible on the map in the lower right corner, Figure 2, as most of them are one-plant corporations.

The United States Steel Corporation was formed in 1901 through the merging of Andrew Carnegie's company, with all its steel mills in Pittsburgh, the Federal Steel Company, with main facilities in Chicago, and eight other corporations. This gigantic merger consolidated large companies which themselves had been formed through mergers in the sudden concentration movement, 1898–

1900. It was carried out by Judge Elbert H. Gary, president of the Federal Steel Company, and Charles M. Schwab, director of the Carnegie Company, with the financial backing of J. Pierpont Morgan. It was made possible by the fact that Andrew Carnegie wanted to sell his company, the leading steel producer in the world, and go down in history as America's greatest philanthropist.

U. S. Steel's capacity has increased from 10.6 million tons in 1901 to 41.9 million in 1959. But its share of the national capacity has decreased. It was 44 per cent in 1901, reached a high of 52 per cent in 1907, and amounted to 28 per cent in 1959. It was by far the slowest growing of the eight largest steel corporations in the 1948–1959 period. Employment grew from 168,000 in 1901 to 271,000 in 1957. No *country* except the Soviet Union has a larger steel capacity than U. S. Steel. The company has often appeared before the federal agencies handling the antitrust laws. Just before World War I the government even considered its dissolution as a violator of the Sherman Antitrust Act.

Among important changes affecting the location pattern of U. S. Steel since its formation in 1901, the following may be mentioned:

A large integrated steel mill was built on the sand dunes south of Lake Michigan, 1906–1911. The plant and city were named in honor of Judge Gary. The city is now part of the urbanized area of Chicago. The Gary plant was later enlarged and modernized and for a long time was the world's largest single steel mill. In 1959 it was a close second to the Sparrows Point Works at Baltimore, owned by the Bethlehem Steel Corporation, both with about 8 million tons capacity. The Gary works was the second large steel mill of the U. S. Steel in the Chicago area; the first one had been established at Calumet Harbor in 1880,[12] thereby initiating the tremendous development of heavy manufacturing in southern Chicago on both sides of the Illinois-Indiana state line (Fig. 1, Inset 1).

In the financial panic of 1907, U. S. Steel acquired control of the largest steel company in the South, the Tennessee Coal, Iron, & Railroad Company, which after 1886 had started to make Birmingham an important iron and steel center. It was even competing north of the Ohio River with pig iron.

A steel plant was completed at Duluth in 1915 after threats by the state of higher taxes on ore shipped out of Minnesota. This plant, far away from the large steel markets, has experienced a very modest growth.

The greatest change in the Corporation's operations took place in a ten-year period from 1928 to 1938, with a concentration at the best located and most efficient plants.

In 1931 U. S. Steel purchased a steel company on the Pacific Coast with facilities in Los Angeles and near San Francisco (Pittsburg). During World War II the government built a large integrated steel mill at Geneva, Utah, to produce steel for the large wartime shipyards on the Pacific Coast. U. S. Steel was called upon to construct and operate the mill, which cost 202 million dollars. It went into operation in 1943. After the war it was sold to the highest bidder, U. S. Steel, for 47 million dollars (1946).

In 1951–1952, U. S. Steel built an integrated Atlantic Seaboard mill of 1.8 million tons capacity at Morrisville, Pennsylvania, across the Delaware River

[12] J. B. Appleton: *The Iron and Steel Industry of the Calumet District*, University of Illinois, Studies in the Social Sciences, Vol. 13, Urbana, 1927.

from Trenton, New Jersey. Named the Fairless Works, in honor of the president of the corporation, it was later enlarged to a capacity of 2.7 million tons. It is the only plant of the U. S. Steel east of Buffalo-Johnstown, an area dominated by the Bethlehem Steel Corporation. The latter company has acquired land near Gary on the southern shore of Lake Michigan—in U. S. Steel "territory"—but no steel mill has been built here so far.

The large U. S. Steel capacity is concentrated in a few plants in even fewer steel centers (Fig. 2). Its Morrisville plant has roughly the same capacity as the total steel industry of Sweden, and Gary equals the capacity of Belgium. About 59 per cent of the corporation's capacity is located in Chicago and Pittsburgh (see map and diagram, Fig. 2).

Bethlehem Steel Corporation. The first president of the U. S. Steel, Charles M. Schwab, resigned in 1903. His health broke shortly after the gigantic merger in which he had taken an active part. In 1904, after a long rest abroad, Schwab organized a new company which acquired shipyards and a steel mill at Bethlehem in the Lehigh Valley of eastern Pennsylvania. This area had been the leading American iron producing region for about two decades before the Civil War, based on anthracite coal and local ore deposits. The Bethlehem plant had an ingot capacity of 190,000 tons. From this small beginning Schwab built up a concern which for a long time has been second only to U. S. Steel among American steel companies. During World War I the company acquired a rail-producing steel plant at Sparrows Point, built in 1887.[20] This plant, favorably located to supply the large Atlantic Seaboard market, the growing West Coast market, and foreign markets, was entirely redesigned to produce a wide and diversified group of products. Its capacity was expanded seven times in a decade to 1.75 million tons in 1926.[21] With a capacity of 8.2 million tons, it is now the world's largest steel mill. It is based on imported ores, especially from Latin America. In 1917, Bethlehem Steel bought a large steel mill in Johnstown, and in 1922 it acquired the Lackawanna Steel Company with its large plant on the outskirts of Buffalo. The latter mill had been moved from Scranton in the Anthracite Region of eastern Pennsylvania to Lake Erie about the turn of the century, to take advantage of low freight costs for iron ore and the growing markets along the Great Lakes while retaining its favorable location for supplying the Atlantic Seaboard market. In 1930, two small steel companies on the Pacific Coast were acquired with facilities in Los Angeles, San Francisco, and Seattle.

Republic Steel, a leading manufacturer of alloy steels, including stainless and high-tensile steels, is an important producer of steel for the automotive industry. It was incorporated in 1899 as a consolidation of 24 bar and forge iron manufacturing companies.[22] The present company was formed through a merger in 1930, which made it the country's third largest steel corporation with a capacity of 5.6 million tons. In the period, 1935–1937, Republic Steel acquired four steel companies. It bought the Gadsden plant in 1937. Since 1941, the company's electric furnace capacity has increased very much; it is now largest in the industry. Dur-

[20] P. Blood: "Factors in the Economic Development of Baltimore, Maryland," *Econ. Geog.*, Vol. 13, 1937, pp. 187–208.

[21] C. Langdon White and Edwin J. Foscue: "The Iron and Steel Industry of Sparrows Point, Maryland," *Geogr. Rev.*, Vol. 21, 1931, pp. 244–258.

[22] *Report of the Federal Trade Commission on the Merger Movement*, A Summary Report, Washington, D. C., 1948.

ing the war a new steel plant was built in Chicago.[23] Sixty-nine per cent of Republic Steel's capacity is located in northeastern Ohio.

Jones & Laughlin Steel Corporation is an old Pittsburgh company, its roots extending back to 1853. The present company was formed in 1902 when two firms on opposite sides of the Monongahela River merged. They had existed for about 40 years with substantially common ownership. The new company had a capacity of one million tons. Its mill is the only plant that can be seen from downtown Pittsburgh, the only one within the corporate limits of the steel city.

In 1912, Jones & Laughlin completed a new mill a few miles down the Ohio River at Aliquippa, which is now part of the Pittsburgh Urbanized Area. The assets of a steel company in Cleveland were acquired in 1942 and in 1958 a small steel plant was bought in Detroit. The last two acquisitions indicate a shift—even if it got a late start—to the lake metropolises.

National Steel was formed in 1929 by merging a steel company with a mill at Weirton and one with a plant at Detroit. Plant sites owned by National Steel at Chicago and in New Jersey have not been utilized so far.[24]

Youngstown Sheet & Tube, incorporated in 1900, got its present name in 1905. One of its Youngstown plants was acquired in 1923 and that same year the Indiana Harbor (Chicago) mill was bought.[25]

Inland Steel, largest of the American one-plant corporations, was incorporated in 1893.[26]

Armco Steel has grown out of a sheet rolling mill at Middletown, Ohio, built around the turn of the century. Before entering the steel business, the founder, George M. Verity, had been manager of a steel roofing concern in Cincinnati. After having considered different locations, Verity in 1909 decided to build a new, large steel mill in his home town. The home plant at Middletown is the largest and most rapidly expanding of the eight steel mills of the company. Armco is the only steel corporation approaching U. S. Steel in the wide geographic distribution of its operations. It acquired several small companies in the 1917–1937 period. Its name was changed in 1948 from the American Rolling Mill Company to Armco.

The *Kaiser Steel* plant (Fontana, California) was built during World War II by Henry Kaiser, who built ships at seven shipyards and badly needed steel plates. It was originally planned for a tidewater site in Los Angeles, but the government, probably under the influence of the Pearl Harbor catastrophe, refused to lend money unless the plant was located some 50 miles inland.[27] About 1.4 of the 2.1 million tons added to the capacity in the 1948–1959 period were in the form of basic-oxygen or LD-capacity.[28] Coal is hauled 810 miles from Sunnyside, Utah, and some also from Oklahoma, a distance of 1300 miles. Iron ore comes from the Eagle Mountain mine, 164 miles distant. The company also owns other ore deposits in the Mojave Desert east of Los Angeles. Water is a critical factor for this plant; by recirculating the water it is possible

[23] C. M. White, President, Republic Steel Corporation, Address given by . . . , April 29, 1951. Published by Public Relations Department, Republic Steel Corporation, Cleveland, Ohio.

[24] *Moody's Industrial Manual*, New York, 1958.

[25] *Report of the Federal Trade Commission on the Merger Movement, op. cit.*

[26] *Ibid.*

[27] C. L. White: *Is the West Making the Grade in the Steel Industry?*, Stanford University Graduate School of Business, Business Research Series No. 8, 1956.

[28] For explanation of LD see p. 112.

to keep down the requirements to a small fraction of what is usually considered to be necessary. The LD-process has further reduced the low coal requirements which is of great importance as Fontana has to pay the highest freight charges on coal of any major steel mill. The trump card of this plant is its location close to Los Angeles which represents about one-half of the steel consumption of seven Western states. This advantage it would have had, of course, even if it had been located on tidewater.

Colorado Fuel & Iron (chief plant at Pueblo, Colorado; smaller plants at Claymont, Delaware; Buffalo and Roebling, New Jersey).[29]

Wheeling Steel (Steubenville, Ohio).

McLouth Steel (new mill in Detroit, LD- and electric furnaces).

Ford Motor (Detroit).

Sharon Steel (Farrell and Youngstown).

Pittsburgh Steel (Monessen).

Detroit Steel (Portsmouth, Ohio).

Granite City Steel (Granite City, suburb of St. Louis).

Crucible Steel Company of America (chief plant at Midland, Pennsylvania; smaller plants at Syracuse, New York and Harrison, New Jersey; the latter is smaller than 10,000 tons and is not shown on the maps. It is the smallest plant listed, the only one left out because of size).

International Harvester (Calumet area in Chicago).

Acme Steel (new LD-mill in Chicago, Cincinnati-Newport).

THE LEADING CANADIAN STEEL COMPANIES

Four companies dominate the Canadian steel production: the Steel Company of Canada (Stelco) and Dominion Foundries and Steel Company (Dofasco), both with plants at Hamilton, Algoma Steel Corporation at Sault Ste. Marie, and Dominion Steel and Coal Company (Dosco) at Sydney.[30] They produce about 90 per cent of Canada's steel ingots. Almost all of the remainder is produced from scrap in electric furnaces at seven small mills at Hamilton and six other places (Fig. 1).

Stelco was formed in 1910 by merging five small Ontario companies. The company owns coal mines in West Virginia and Pennsylvania, and iron mines in Minnesota and Michigan.[31] It is the largest steel producer in Canada, accounting for almost 50 per cent of the total Canadian capacity. The first blast furnace was built in Hamilton in 1895, mainly because of tax concessions offered by the city, and two years later a steel mill was constructed. Now Hamilton has the same advantages as other steel centers with a coastal location and a situation close to the market. At least 60 per cent of the steel is sold south of a line from just east of Toronto to Sarnia, where most of Canada's automobiles, farm machines, and domestic appliances are manufactured. Dofasco, enjoying the same locational advantages as Stelco, was formed in 1917 and became a fully integrated steel mill in 1951. In recent years it has been the fastest growing Canadian steel company.

The two other steel corporations in Canada have peripheral locations.

[29] This plant is shown as unchanged on Figure 1, with small decrease on Figure 2.

[30] The discussion of the Canadian steel industry draws heavily on a paper by Donald Kerr, which has the same company-approach as followed in the present study. Donald Kerr: "The Geography of the Canadian Iron and Steel Industry," *Econ. Geog.*, Vol. 35, 1959, pp. 151–163.

[31] Raw materials for the steel industry move in both directions over the national boundary. The direction of shipments depends not only on transportation costs and c.i.f. prices, but also on ownership of mines. American companies own mines in Canada and Canadian firms have acquired mines in the United States.

Dosco is one of the great industrial empires in Canada, employing over 30,000 people. Its steel operations at Sydney are only one part of a complex including coal, iron and limestone mines, shipyards and shipping, as well as numerous steel fabricating mills. The present company was formed in 1928. It can be traced back through several mergers to some small companies which began smelting iron ore at the coal fields of eastern Cape Breton Island during the nineteenth century. Coal from nearby company mines makes a rather poor coke. Iron ore is hauled by company ships from company-owned mines on Bell Island (Wabana) off the east coast of Newfoundland. The steel plants at Sydney in the early years of this century specialized on rails (*cf.* Sparrows Point). After World War I the demand for rails fell off greatly. Subsidiary plants manufacturing various steel products were gradually acquired in the Canadian Manufacturing Belt, and these plants now absorb a large share of the production. Rails are, however, still very important, accounting for about 40 per cent of total production. The Sydney mill has the poorest location of any in North America as the domestic market is by far the most important for all mills. Sydney is the slowest growing of the "big four" Canadian plants. Because of its importance in the economy of the "underdeveloped" Nova Scotia it is unlikely that the government would ever permit this mill to be closed down.

Algoma's mill at Sault Ste. Marie is also off center and its location is similar to that of the Duluth plant. It was built in 1902 as a result of a personal initiative to develop electric power on the St. Mary's River. A pulp mill and a ferro-nickel plant had been built a few years earlier, and the ferro-nickel industry was stimulated by the discovery of ore at Michipicoten, 120 miles to the north, and the construction of the steel mill. The demand for rails on the prairies led to an expansion of the steel facilities. The mill now uses primarily American ores. The mine at Michipicoten was closed from 1921 to 1939 but then was reopened. Because of its high manganese content the ore commands a high price, and the company sells most of it on the American market and imports cheaper American ores. Rails are still an important item on the production program. The company has specialized on products which are not manufactured at Hamilton and can sell these products in the Manufacturing Belt and ship by water. The Mannesmann Tube Company recently built a plant at Sault Ste. Marie, the first large consumer to locate near the mill. This was a result of the postwar development in the Canadian oil industry in the Prairie Provinces.

In the future it seems that the Montreal area, now the largest deficit region for steel in Canada, will become a steel center. Stelco is building a small pipe mill at Contrecoeur, 30 miles northeast of Montreal on the shore of the St. Lawrence River. Dosco will build a rolling mill at the same place and, eventually, a steel plant.

SMALL STEEL COMPANIES IN ANGLO-AMERICA

Companies with less than one million tons capacity have 9 per cent of the capacity in the United States. Those of one-half to one million tons, most of them one-plant corporations, account for by far the largest part of this capacity. Plants of this size would be considered large in many countries in Europe.

The many small, scrap-based electric-furnace mills scattered over the continent, with capacities of 25 to 100 thousand tons, account for an insignificant

share of the total capacity. The plant at Jackson, Mississippi, may illustrate the reasoning which underlies several such plants. Birmingham is the nearest competing steel center. The freight rate for steel from Birmingham is 8 dollars per ton. For scrap the rate to Birmingham is 6 dollars per ton. Electric power rates in Jackson compare favorably with rates in the surrounding states. A survey had indicated that Mississippi was using 60 to 70 thousand tons of steel a year, which could be produced on a small bar mill.[32] The economy of scale in Birmingham thus apparently was outweighed by savings in freight costs, at least for the Jackson market. The Jackson company was financed by the sale of common stock and debentured bonds to residents of Mississippi.

COMPANY SIZE AND INNOVATIONS IN STEEL TECHNOLOGY

In the United States the most striking technological innovations seem to have been introduced not by the gigantic U. S. Steel with its tremendous resources for research and experiments, nor by the second largest corporation, the expansive Bethlehem Steel, but by companies of second or third magnitude.

The most important innovation of the 1920's, the continuous rolling mill, was introduced by the American Rolling Mill Company, now Armco, at its Ashland (AS) plant in 1923 and perfected at its Butler (BU) plant in 1926 (Fig. 1 and Table I). It was immediately adopted by the industry under licenses from Armco. In 1954 about 40 wide continuous hot-strip mills were in operation in the United States, with an aggregate capacity of 40 million tons.[33]

Republic Steel became a leading manufacturer of alloy steels in the 1930's by absorbing companies specializing in this rapidly expanding field. This company also pioneered "high-pressure smelting," an innovation that reduces the amount of fuel required in the blast furnace and increases the recovery of iron from the ore.[34]

In the 1950's the steel industry entered a new revolution in steel making techniques. For the first time since the end of the last century new steel processes have been developed. The basic-oxygen process, commercially put into operation for the first time in the small Austrian steelworks at Linz and Donawitz in 1952 after three years of experimental production, is the most important of these. Usually referred to as the LD-process, it is rapidly becoming a major steel making technique all over the world. The first LD-steel in Anglo-America was made at Dofasco's plant at Hamilton in 1952 and commercial production was started here in 1954. Dofasco is the smallest of the "big four" steel companies in Canada (see p. 110). The McLough Steel at Detroit started production without previous pilot plant operation the same year.[35] Linz, Donawitz, Hamilton, and Detroit were the only steel centers with LD-capacity in 1954. Five years later there were two Canadian (at Hamilton and Sault Ste. Marie) and four American (Detroit, Pittsburgh, Fontana, and Chicago) steel plants with combined LD-capacities of 1.1 and 4.0 million tons respectively. In 1959 the total world ingot capacity for LD-steel is over ten million tons.[36] Kaiser Engineers, the

[32] Letter from Mr. W. H. Stewart, President, Mississippi Steel Corporation.

[33] *The Making, Shaping and Treating of Steel*, United States Steel, Seventh Edition, Pittsburgh, 1957, p. 587.

[34] E. B. Alderfer and H. E. Michl: *Economics of American Industry*, Second Edition, New York, 1950, p. 60.

[35] C. R. Austin: "Oxygen Steel in the United States," *Iron and Steel Engineer*, Vol. 33, 1956, pp. 64–68.

[36] *L-D Process Newsletter*, Kaiser Engineers Division of Henry J. Kaiser Company, Oakland, February 27, 1959.

authorized licensor in the United States for the process, act under arrangements with Brassert Oxygen Technik of Zurich, Switzerland, which owns and controls the basic patents. They forecast that world LD-tonnage will account for 35 per cent of the total steel making capacity by 1965; it will approach 120 million tons.[37]

The Swedish Kaldo process, developed at Domnarfvet by Professor Kalling, and the German Rotor process, developed at Oberhausen, both similar to the LD-process, have not yet been introduced into Anglo-America.

In 1959, Jones & Laughlin was the only one of the eight largest steel companies making basic oxygen steel (at Aliquippa, Pittsburgh). This company had decided to start construction of the two largest basic oxygen furnaces in the world at its Cleveland plant in the summer of 1959. They are expected to produce 160-ton-heats and will have an annual capacity of 1.2 million tons. Eight adjacent 175-ton open hearth furnaces, constructed in 1924, will be deactivated.[38] Also other of the eight largest companies (e.g., Republic and Armco) are actively interested in building basic oxygen furnace capacity.[39]

What are the reasons for the rapid acceptance of the new process, which had to await the recent innovation of bulk producing methods in oxygen manufacturing? (Cheap oxygen is also used in conventional steel processes, but the new converters are specially designed for this technique.) The LD-converter seems to be more economical than conventional steel processes, both in construction costs and in operating expenditures, and it has a greater versatility than the open-hearth furnace prevalent in Anglo-America. For a capacity of 800,000 tons a year the investment in LD-furnaces has been estimated at 13 to 15 dollars per annual ton, in electric furnaces at 18 dollars a ton, and in open hearth at 33 dollars. This is exclusive of oxygen generating facilities for LD and power stations for electric furnaces. Comparisons between open hearth and LD are complicated by differences in charges. Oxygen furnaces operate with a maximum of about 30 per cent scrap and often much less, whereas open hearth charges have in recent peak periods averaged about half scrap and half hot metal. If the extra coke oven and blast furnace capacity needed for LD is considered, the overall investment for a completely new mill would be roughly the same for LD and open hearth.[40] But as found in this study, new mills are exceptions and additions to existing plants are the rule. For mills that can increase pig iron capacity at low cost the oxygen process offers clear-cut capital savings.

Republic Steel recently announced that it had an even more radical innovation, producing steel strip from iron powder and thus eliminating coke ovens, blast furnaces, steel furnaces, and blooming mills, on an experimental stage in its research center at Cleveland. A commercial plant will not be built for five or six years, but such a plant would cost only 40 to 50 per cent as much as installations used in the conventional melting process. Similar experiments have been under way in Europe (Domnarfvet, Sweden) for about five years.[41]

[37] Letter from Mr. R. A. Bateman, Manager, Public Relations, Kaiser Engineers, Division of Henry J. Kaiser Company, March, 1959.

[38] News Release, April 30, 1959, Public Relations and Advertising Department, Jones & Laughlin Steel Corporation, Pittsburgh.

[39] *The New York Times*, June 14, 1959.

[40] G. J. McManus: "Low Capital Cost Spurs Swing to Oxygen Steel," *The Iron Age*, Vol. 181, 1958, pp. 55–58.

[41] *The New York Times*, June 19, 1959.

THE FUTURE

It is too early to forecast the influence of these innovations on the future location pattern of the Anglo-American steel industry. It seems, however, that the pull of iron ore will increase, that of coal will continue to decrease. This does not mean that peripheral ore fields and shipping ports for ore will get most of the new steel capacity. It is more likely that the large urban agglomerations (large markets) with coastal location (cheap iron ore) will be the beneficiaries. The tendency of making steel to more and more exacting customer specifications, sold on a hand-to-mouth basis, will probably be strengthened by the great versatility of the LD-process, by which steel is made in relatively small heats in a very short time.

The "law" of industrial inertia will continue to work; it is not likely that the steel pattern will undergo any revolutionary changes in the next decade. It will probably continue to change primarily through differences in growth rate rather than by additions of new steel plants and closing down of old ones.

ACKNOWLEDGMENTS

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FARM CONSOLIDATION AND IMPROVEMENT IN THE NETHERLANDS: AN EXAMPLE FROM THE LAND VAN MAAS EN WAAL

Audrey M. Lambert

Dr. Lambert is Lecturer in Geography at the London School of Economics and Political Science. She has traveled widely in the Netherlands and was able to study several of the country's reconstruction problems in the field.

OF the many problems confronting west European agriculture, those of the very small farm—too small to provide the farmer and his family with a reasonable standard of living—and of the fragmented farm, with its plots and fields widely scattered, are among the most intractable. Fragmentation, whether due to the persistence of the medieval open-field pattern of strip cultivation, to piecemeal reclamation from the waste in past centuries, or to the systems of land inheritance or tenure prevailing currently or in earlier times, is a serious obstacle to efficient farm management. Farmers must spend much time traveling between the village and the various plots, or between one plot and another. The quality of the farming suffers in consequence since the land furthest from the homestead tends to be neglected while that closer at hand is too frequently cropped. There are also difficulties of drainage and access.

In most countries where fragmentation of holdings persists attempts are now being made at remedial action. In Britain, parliamentary enclosure in the late eighteenth and early nineteenth centuries led to increased agricultural efficiency, but at the cost of considerable social upheaval and distress. Many small owners were forced to sell their plots because they were unable to afford the high cost of road-making, fencing, and drainage; these small allotments were then added to the lands of the larger farms, while at the same time some landlords took the opportunity to throw together the smaller farms in their possession to make larger and more economic agricultural units. Numerous small farm owners and tenants were thus impoverished or dispossessed.

Modern government policies seek to obtain the benefits of consolidation of scattered holdings while avoiding such consequences. The various national plans differ greatly in their scope. Thus in Belgium little more is attempted than an exchange of parcels to facilitate farm management, whereas in the Netherlands consolidation generally forms part of coordinated schemes of rural reconstruction which attempt to take into account the well-being of the entire rural community. Sociological considerations are often as important as the reallocation of the land and any technical improvements which may be introduced. Thus agencies seek to foster the development of community consciousness among the farmers, and to hasten the breakdown of the physical and intellectual isolation of the rural areas.

THE PROBLEM IN THE NETHERLANDS

It has been estimated that in the Netherlands over 75 per cent of all farm holdings are either too fragmented or too small for rational economic management.[1] Therefore, in a country with a rapidly increasing population on a very small surface area and with a growing number of young farmers who are unable to find a farm to rent or buy, it is essential that the fullest and most intensive use be made of all agricultural land. To this end the Netherlands government has sought to encourage farm consolidation, and the various ministries cooperate in the Central Committee for Land and Water Use under the presidency of the Director-General of Agriculture of the Ministry of Agriculture, Fisheries and Food.[2] The executive body is the Government Service for Land and Water Use (Cultuurtechnische Dienst) together with a variety of special agencies which exist to deal with specific aspects or areas, such as the Reallotment Commissions for Zeeland and Walcheren (Herverkavelingscommissies Zeeland en Walcheren), the Foundation for the Development of Basin-Soil Areas (Komgrondenstichting), and the Government Advisory Services (Rijkslandbouwvoorlichtingdienst). Close contact is also maintained with the various highly specialized departments of the State Agricultural College (Landbouwhogeschool) at Wageningen.

Farm consolidation began in 1924 when the Dutch parliament first granted the necessary powers. Prior to this, consolidating activities in the Netherlands were negligible, the only method then being the exchange of plots by mutual agreement of the farmers, which was practicable and occurred only in isolated instances. But between 1924 and December 31, 1958, reallotment and farm consolidation had been completed for an area of 125,600 hectares (Fig. 1), and at the latter date was in progress in a further area of 200,940 hectares (of which 36,800 hectares were being dealt with under special acts for the areas in Zeeland and Walcheren devastated by the sea floods of February 1, 1953). In addition, requests had been made for the consolidation of a further 1,213,400 hectares, making in all a total of 1,539,940 hectares or over 50 per cent of the land available for agriculture. Application for land consolidation has to be made by at least one-fifth of the owners and occupiers in the area concerned. If a scheme is then devised and approved for a government subsidy it is referred back to the inhabitants of the district, who vote to decide whether it shall be undertaken. At the present time the Ministry of Agriculture has received so many applications for consolidation that, with the resources in men and money currently available (including American aid), work can be tackled only in those districts where farm consolidation and improvement are most urgently needed.

While such fundamental changes in the rural economy can be undertaken for limited areas only, the Netherlands Agricultural Advisory Services have established some 36 pilot schemes for demonstrating methods of agricultural

[1] The *Verslag over de Landbouw in Nederland over 1957*, the Hague, 1959, Table B 18, p. 375, gives the number of agricultural and horticultural holdings as 314,000 on a cultivated area of just over 2.3 million hectares, an average of barely 7.5 hectares per holding. Of the exclusively agricultural holdings, approximately 30 per cent are from 1–5 hectares, a further 30 per cent from 5–10 hectares and 25 per cent from 10–20 hectares in extent. Thus 85 per cent of all farms are of 20 hectares (about 50 acres) or less in size.

[2] The Ministries represented on the *Centrale Cultuurtechnische Commissie* include those of Agriculture, Housing, Transport, and Education, and also the Treasury and Home Office.

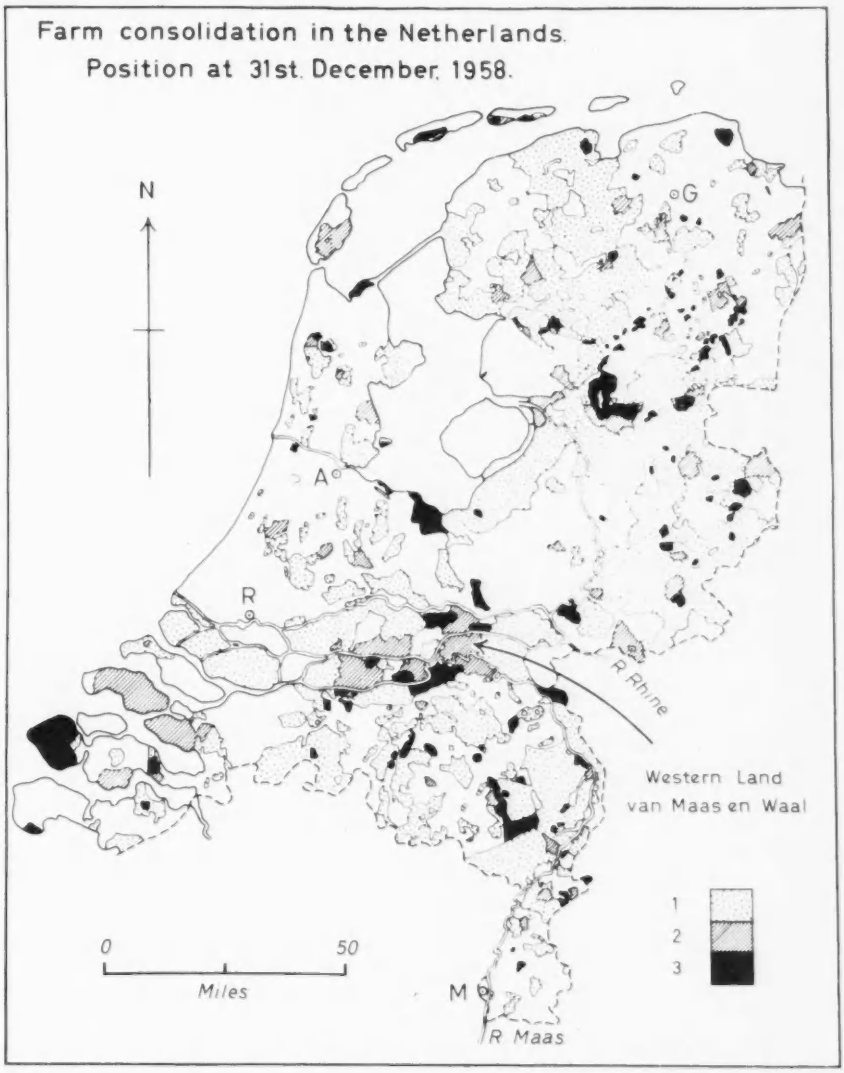


FIG. 1. Farm consolidation in the Netherlands. Key: 1, consolidation applied for; 2, consolidation in progress; 3, consolidation completed; A, Amsterdam; G, Groningen; M, Maastricht; R, Rotterdam. (After data in *Jaarverslag 1958*, of the *Centrale Cultuurtechnische Commissie*, the Hague, 1959.)

improvement which can be applied more widely in regions that, for one reason or another, are backward in farming practice. These pilot areas together cover more than 200,000 hectares and fall into three broad groups. First, there are the areas where the mere application of modern practices and sound systems of farm management would lead to a larger financial return for the farmer; second, those where a radical improvement in farming condi-

tions is necessary and financial assistance from government sources will be required; and third, the regions where not only the conditions for agriculture but the entire economy need to be overhauled if improved living standards are to be achieved.

AN AREA REQUIRING RURAL RECONSTRUCTION

The basin-soil or back swamp areas (*komgronden*) of heavy clay and alluvium inside the levees or dikes of the lower Rhine, Waal, and Maas fall within the second category noted above, for they formed a large tract characterized by highly fragmented farms, with nearly 100,000 hectares of *extensively* exploited pastures. The need for farm consolidation and improvement, with more *intensive* use of the land, was apparent here, and schemes of rural reconstruction are in hand for the western Land van Maas en Waal and the neighboring areas of the Bommelerwaard and the Tielerwaard. In the last and by far the largest of the three areas, the reallocation of some 250 holdings and the building of an equal number of new farmsteads is planned, while development is already far advanced in the other two. Fifty-six new farmsteads have been erected in the central basin-soil areas of the Bommelerwaard and 96 in the western Land van Maas en Waal. This last-named district, lying between the villages of Dreumel, Puiflijk, Leeuwen and Maasbommel (Fig. 2b), is one of the most advanced and important of the pilot areas and has thus been selected for special study in this paper as an example of the methods employed in rural reconstruction and land consolidation in the Netherlands.

This interfluvial region of some 8400 hectares, built up of debris brought down by the rivers Rhine, Maas, and Waal, was formerly subject to frequent floods. Where the current was checked near the river banks the coarser sandy materials were dropped (Fig. 2a) to form belts of levee soils (*stroomruggronden*), while further from the main channels finer silts were deposited to form the heavy basin-clay soils of the interior (*komkleigronden*). Between these two occurs a zone of varying width where the lighter levee soils overlie the basin-clays, and within the central basin occasional ridges of sand or sandier clays are found. On these ridges and more especially beside the dikes lay the farms, villages, and roads, for even after the region was diked in the Middle Ages floods still occurred, transforming the interior into a lake during the winter so that the heavy clay lands were devoid of settlement. Where dike bursts have occurred, patches of alluvium (*overslaggronden*) remain and provide areas suitable for horticulture, while in a few places small patches of Pleistocene sands outcrop. Beyond the dikes the marsh soils (*uiterwaardgronden*) extend down to the main streams and are still subject to annual flooding.

Before the program of rural reconstruction was undertaken, farming was generally backward and farm incomes low by comparison with similar districts elsewhere. The rivers which had built up the area had also served to isolate it from other parts of the country, and the ringing levees made drainage of the interior *komgronden* difficult. Parts of the basin-clay country were waterlogged the whole year through and overgrown with swamp horsetail (*Equisetum palustre*) and other plants unsuitable for dairy cattle. Some portions of the *komgronden* were inaccessible for several months each year and could be used only for haymaking or as pasture for horses and young cattle. The par-

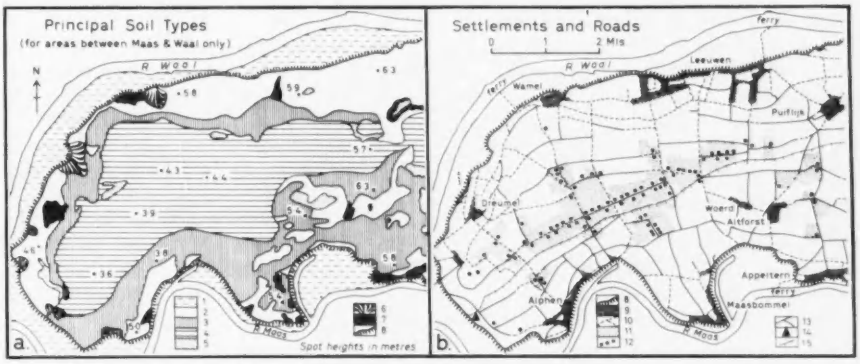


FIG. 2. Rural reconstruction in the western Land van Maas en Waal. Key: 1, marsh soils (*uiterwaardgronden*); 2, levee soils (*stroomruggronden*); 3, levee soils overlying basin-clay soils; 4, basin-clay soils (*komkleigronden*); 5, Pleistocene sands; 6, dike-burst spill soils (*overslaggronden*); 7, ancient settlement soils; 8, main dikes; 9, chief settlement sites before rural reconstruction; 10, metalled roads in existence in 1951; 11, basin-soil areas improved between 1953 and 1956 inclusive; 12, new farm buildings erected in same period (not to scale); 13, roads built or metalled by the end of 1956; 14, new electrical pumping station for water control of the whole area; 15, main drainage canal. (Compiled and generalized from data of the *Ministerie van Landbouw, Visserij en Voedselvoorziening, Cultuurtechnische Dienst*, and the 1:50,000 map of the *Ministerie van Oorlog, Topografische Dienst*.)

cels of the individual holdings were also widely scattered, some plots lying over five miles distant from the farmhouse, which, situated on the dike flank, often had insufficient land about it for an adequate farmyard. The state of the farmhouses reflected the general backwardness and economic poverty of the area. Many were unfit for human habitation. Moreover, the outmoded design of the farm buildings obstructed all attempts at scientific farm management.

The isolation and poverty were again reflected in poor social conditions. The population (approximately 16,700 in 1954) was educationally backward and, while primary schooling facilities were reasonably adequate, few children went on to centers of higher education. Many families did not appreciate the value of more advanced study, even at the Landbouwhogeschool, and preferred to have their children earning or working on the family holding. This negative attitude also resulted in new ideas penetrating into this region more slowly and the value of farmers' cooperatives and of the Government Advisory Services being much less appreciated than in other, more favored districts.

PLANNING AND EXECUTION OF THE SCHEME

Rural reconstruction work started in the basin-clay districts of the western Land van Maas en Waal about 1945, but the greatest advances awaited the passing of the Land Consolidation Act of 1954 which made possible the total reorganization of the area. Besides improving the shape and compactness of farms, reconstruction involved the amalgamation of undersized holdings, water control, and soil improvement schemes, together with slum clearance and the building of new farmsteads. Such schemes were obviously beyond the limited means of the farmers themselves and much thought was, therefore, given to the amount and form of government subsidies and the proportion of the improvement costs which the

peasants could reasonably be expected to pay.

The planning and execution of the scheme required careful integration of the technical, social, and economic sections of the work. The initial phase was applied mainly to research. A detailed physical survey was made of soils, micro-relief and drainage, natural vegetation, and climate; the suitability of various crop strains and rotations was assessed and the types of manures and artificial fertilizers required to produce a good soil structure were investigated. These researches were closely linked to those of the agricultural economists, studying the size and type of farm (arable, pastoral, or mixed) most suited to the area, and the most economical and convenient form of farm buildings which would enable the farmer to draw the greatest financial return for his labor. At the same time housing conditions were being surveyed to discover to what extent slum clearance and improvements in services, such as water and electricity supply, were needed. In addition the character of the social groups within the area was studied, since knowledge of these groupings, whether based on the family, on religion, or on identity of employment, formed the basis for the designing of the types of accommodation required and the pattern of settlement.[3]

Research alone was not enough. The success of the whole plan depended, in the last resort, on the active cooperation of the local population. A campaign of propaganda and persuasion, conducted by means of lectures, discussions, films, leaflets, and numerous individual conversations over a period of many months, sought to convince the population, conservative in many of its farming practices and in its ideas and customs generally, of the value to them of so great a break with their traditional farming methods and such a radical change in their whole way of life. For this reason the help and advice of the most influential members of each village was assiduously sought since their attitude might sway that of the whole community. In many ways this approach resembles the parallel procedure in the Danish Folk High Schools during the great changeover in agricultural emphasis from wheat to dairying in nineteenth-century Denmark.

Upon the completion of the initial research a preliminary plan of the layout of roads, canals, and drains, and of the reallotment of the parcels was drawn up and submitted to the inhabitants for their approval. Once the general consent for the pooling and reallocation of the land had been obtained, the Government Service for Land and Water Use took over a block of some 8–10,000 hectares between the villages of Wamel, Dreumel, Puiflijk and Altforst. The need to reduce the number of undersized farms meant that some of the inhabitants had to be bought out. A few were willing to sell their farms; others were offered holdings or employment in the new North-East or East Flevoland polders, while yet others went into industry. Some emigrated to the manufacturing centers, but others found work in small local industries such as the glassworks at Altforst and the brickworks along the Waal, whose development was encouraged to help in the absorption of surplus rural labor, especially the rural youth for whom there was no place on the land.

The major constructional works were begun in 1952 with the building of a

[3] In some districts it is customary for the aged parents to continue to live in the farmhouse when the eldest son takes over the management of the farm. New farmhouses had, therefore, to provide adequate separate accommodation for the son and his family and for his parents.

main drainage canal and pumping station for the water control of the whole area, and the construction, on beds of specially transported sand, of a network of metalled roads into the basin-clay areas. Upon the completion of the canal, in 1953, and of some of the access roads, the reclamation of the *komgronden* was begun. This pioneer work was undertaken by the farmers who had volunteered to leave the dike villages for new farms in the basin-clay regions, and was carried out entirely under government supervision. Drainage ditches up to six feet deep were dug between the individual farms by special plows drawn by three tractors in tandem, and the fields were then leveled and plowed deeply several times. Where the clay fraction in the soil exceeded 80 per cent the former reeds and unpalatable marsh plants were replaced by selected grasses and white clover; the lighter tracts with less than 60 per cent clay fraction were put to arable use, the principal crops being beet and cereals, while the use, whether arable or pasture, of the intermediate group of soils with 60–80 per cent clay fraction depended primarily on the local peculiarities of relief and drainage. In the fields tile drains were used so that few ditches interrupted the lands of the individual holdings, and this, combined with the new layout in rectangular plots, now facilitates mechanical methods of tillage and the use of electric fencing for controlled grazing of the pastures.

As reclamation got under way an intensive educational program was started. Both mass and individual methods of instruction were used by the Government Advisory Officers: hundreds of visits were paid to the farmers' homes, vocational training by classes and by group discussions introduced them to new technical methods, while their wives were given courses in home economics and allied topics. By this means the farmers and their wives were prepared for the changed conditions they would find when they moved into their new homes. The first of the new farms was occupied in June, 1954, and, thereafter, as the *komgronden* were gradually reclaimed, the volunteer farmers were moved, one by one, from the dike villages out to their new farmsteads, each erected in the middle of its lands. The farmhouses they vacated were, when in good condition, used to house laborers from the worst slum-hovels, or, if unsuitable for housing, were transformed into shops, garages, etc., or, in extreme cases, were pulled down.

Within the basin-clay regions each of the new farms occupies a compact, generally rectangular plot of land, with a narrow frontage on the road. The combined farmhouse and farm buildings, with the farmyard, midden, and silage pits, stands in a small garden and vegetable plot near the road. Behind the farmstead the fields stretch back into the basin-soil areas in a narrow strip, divided from the neighboring farms by ditches and from each other by electric fencing. Occasional hedgerows and shelter belts provide some protection for the livestock, while shrubs and fruit trees screen the farmhouse. Within each holding the use of the land for arable crops or pasture depends mainly on the soils; since most of these are heavy some farmers have laid paved cartways from the farmstead to the limit of their holdings so that farm machinery has easy access to all parts at all seasons of the year.

RESULTS

In the western Land van Maas en Waal the new farms range in size from 5 to 15 hectares. Ten hectares was originally thought to be sufficient to ensure an adequate living for the farmer

and his family, but experience has shown that holdings of this size are too small and give the farmer a net income of only 5000–6000 Dutch florins a year (approximately 1400–1700 dollars), which is about the same as the earnings of a skilled farm laborer in that district. In view of this, the plans for the Tielerwaard have been amended and now envisage holdings of a slightly greater size. A typical mixed farm of 11 hectares near Dreumel had, in August, 1958, the following crops and livestock:

0.9	hectares	potatoes	8 cows in milk
0.9	"	oats	5 young cattle 1–2 years old
0.9	"	barley	
0.9	"	peas	10 calves under 1 year
1.4	"	sugar beet	1 horse
0.5	"	fodder beet	7 pigs
5.5	"	grassland	120 chickens

The farmer on this holding considered that in 1958 the return, for his and one son's labor, would total 6000 Dutch florins (a reasonable estimate in the view of the Government Advisory Officers). It represents an income of only 3000 florins per full-time worker, or half that of a skilled laborer. Nevertheless, it is clear that, although the financial return from these farms is modest, their owners are better off and have to work less hard than before consolidation.

Nor are the farmers who have moved into the new farms of the *komgronden* the only ones to benefit. Those who remained behind in the villages are also better off. Consolidation of the lands between the basin areas and the dikes has made farms more compact and easier to manage. Moreover, improved drainage and roads have been of advantage to all, while in the villages the demolition of unsatisfactory farm buildings has made room for more commodious farmyards and barns. In addition, schemes of modernization have greatly improved the sanitation, convenience, and comfort of many farmhouses.

Any attempt to assess the cost of such rural reconstruction schemes and to measure the resulting increase in productivity is very difficult. On the *komkleigronden*, productivity has more than doubled, but on the lighter soils adjoining the levees the increase has not been so great. Moreover, in calculating the benefit to these regions of the improvement schemes, the great amelioration in social and working conditions which has resulted cannot be evaluated in purely monetary terms. Within the Netherlands the investment in land improvements has ranged from 700 to 7000 florins per hectare, and in the western Land van Maas en Waal drainage costs alone amounted to some 1000–1200 florins per hectare. The costs are apportioned between the government and the farmers, the government subsidy amounting normally to about 75 per cent of the total expenditure. The balance of 25 per cent is paid by the farmers. The buildings of the new farmsteads are also subsidized by the state as to 40 per cent of the cost. A typical farmstead such as that on the holding described above (comprising a dwelling, barn, stable, piggery, and cowshed all under the same roof, but divided by fireproof walls in case of overheating in the haystacks) costs about 40,000–50,000 florins, a relatively low figure due to the widespread use of prefabricated units. Each farmer is expected to pay off the balance for the land improvements and buildings of his farm by a 30-years annuity comprising interest and redemption costs.

Of the three rural reconstruction projects in the basin-soil areas of the lower Rhine and Maas, that in the western Land van Maas en Waal is the most advanced, but even here some work still (August, 1959) remains to

be done. Even when the purely physical work of reconstruction is finished the task of the Government Agricultural Advisory Services will continue. With the farmers established in their new farms, government control over cropping and land use is gradually relaxed, but for a period it will be necessary to maintain a certain amount of vigilance to see that holdings are not neglected and that the drainage ditches, so vital in keeping the land in good condition in these low-lying districts, are cleaned out regularly. Follow-up vocational courses must also be organized to keep the farmers abreast of new developments. At the same time such pilot projects serve as examples of what can be done in backward rural areas with enlightened government assistance and advice, and visits to them and demonstrations by the farmers are arranged so that other districts may be persuaded to follow suit.

WHOLESALE-RETAIL TRADE RATIOS AS INDICES OF URBAN CENTRALITY

William R. Siddall

Dr. Siddall is Assistant Professor of Geography at Middlebury College in Vermont.

URBAN geographers have for many years recognized that one of the functions of a city is to act as a collecting, distributing, and service center for the surrounding territory. This raison d'etre varies widely, however, from one city to another. Some exist solely to serve the surrounding area; others have relatively little connection with their immediate hinterlands. Several methods have been devised to measure the degree of centrality exhibited by various cities. Some of these methods are reviewed in this paper, and two new measures based on wholesale-retail trade ratios are proposed. These measures, one relative and one absolute, are tested on the 56 standard metropolitan areas in the United States of over 300,000 population.

Three Types of Cities

Three main types of cities have been recognized by various urban geographers: the specialized city, the transportation city, and the central place city.[1] The specialized city is one in which various specialized activities are performed. It does not necessarily have any close relations with its immediately surrounding territory but rather draws its support from a larger area. Miami is a specialized city, located where it is because of a pleasant winter climate, fine beach, and warm ocean water, and its specialized activity is tourism. Pittsburgh, another specialized city, located not far from deposits of coking coal and in a convenient place to receive iron ore shipments, specializes in iron and steel manufacturing. It produces steel not only for its immediate hinterland but for most of the United States.

The transportation city is well exemplified by New Orleans, whose primary function is to serve as a break-bulk point where the cargo transfer between ocean-going ships and river barges is accomplished. Imports handled through New Orleans are not distributed solely to the immediately surrounding territory but to large parts of the country.

The third type, the central place city, is the one with which we are concerned in this study. Such a city exists to serve its hinterland, or urban field, as a collecting and distributing center and as a cultural, social, and administrative center. Its relationships with the surrounding area are close and are, in fact, the sole justification for this kind of city. Central place cities are usually found in agricultural areas, but not necessarily so. Fairbanks, Alaska, has historically served as a central place for a population of scattered miners and fur trap-

[1] See particularly C. D. Harris and E. L. Ullman: "The Nature of Cities," *Annals of the Amer. Acad. of Polit. and Soc. Science*, Vol. 242, 1945, pp. 7–17.

pers; and White Plains, north of New York City, has functioned as a central place serving the needs of Westchester County families whose income is derived from occupations carried on in New York. The spacing of central place cities is theorized as being regular, and dependent upon the richness and productivity of the surrounding land.[2]

Centrality, then, is that characteristic displayed by a city which is serving as a central place. It might be defined as the degree of association between a city and its immediate hinterland.

EARLIER SYSTEMATIC ATTEMPTS AT MEASURING CENTRALITY

In actual practice all cities exhibit characteristics of each of the three types; virtually no city is completely devoid of central place functions, but the importance to the city of these central place functions varies considerably from city to city. Many studies of cities have been made in which the degree of centrality is evaluated. Frequently these evaluations are implicit in the operation but are not identified directly as attempts to measure centrality.

One example is furnished by a study made in 1943 by Chauncy Harris in which he classified United States cities according to the predominant activities in which they were engaged as measured by United States Census employment figures for various kinds of industry.[3] Two kinds of central place cities which he identified were the "wholesale centers" and "retail centers." Although wholesaling and retailing are certainly not the only measures of centrality they are perhaps two of the most important ones.

Another approach to the study of cities has been to delimit their hinterlands. An example of this is R. E. Dickinson's study in 1934 in which he delimited the metropolitan regions of the United States.[4] In order to do this he was forced to determine which cities would serve as the central places in each of his regions. He used several criteria to indicate centrality, including merchandising warehouse space, sales effected through branch offices, and the location of Federal Reserve banks. One of his most important criteria was the value of sales per capita.

Wholesale sales per capita and also retail sales per capita have long been popular as measures of centrality. It has been assumed that the total retail purchases per person living within the city does not significantly vary from city to city and that the wholesale purchases attributed to these retail purchases also do not vary. Therefore, high per capita wholesale or retail sales in a city indicate that this city is serving a high proportion of people outside of its own boundaries, and that it exhibits a high degree of centrality. Conversely a small town in which most residents make their purchases at a near-by larger town would exhibit a low degree of centrality (or even a "negative" centrality in a commercial sense).

Unfortunately, however, these assumptions are not strictly correct. Per capita income payments to individuals in 1957 varied from state to state as much as 194 per cent, ranging from $958 and $1151 for Mississippi and Arkansas, respectively, to $2740 and

[2] Walter Christaller: *Die Zentralen Orte In Suddeutschland*, Jena, 1933.

[3] C. D. Harris: "A Functional Classification of Cities in the United States," *Geogr. Rev.*, Vol. 33, 1943, pp. 85–99.

[4] R. E. Dickinson: "The Metropolitan Regions of the United States," *Geogr. Rev.*, Vol. 24, 1934, pp. 278–291.

$2821 for Delaware and Connecticut.[5] A city with a given degree of centrality would have a lower per capita wholesale sales value with a hinterland in Mississippi than with a hinterland in Connecticut. From city to city the variation is less, but far from insignificant. The difference in median family incomes in 1949 between the Tampa–St. Petersburg Standard Metropolitan Area ($2405) and the Washington, D. C., Standard Metropolitan Area ($4262) amounts to 77 per cent.[6] Obviously for a given size city the per capita retail sales (and wholesale sales) to the city dwellers will be of a higher value in the city with the higher median family income. A high per capita sales figure does not necessarily mean, then, that a city is selling more goods to outsiders than another city with lower per capita retail sales figure, nor does it seem that such figures are as good indicators of centrality as might be hoped for. Of course adjustments can be made to account for the regional and urban difference in per capita income but only if the extent of the hinterland is known. Often the hinterland area is not accurately known.

Many other techniques have been used, of course, to measure the centrality of a city; these include analyzing newspaper circulation, telephone calls, bus schedules, auto traffic, employers' payroll addresses, and the number of various specific functions, such as professional services, in proportion to the number of people living in the city.[7] Perhaps the best technique of all is the personal interview. Questions such as "Where do you do your grocery shopping? and "Where do your children go to school?" will probably reveal most accurately the central places.

However, most of these techniques are better adapted to intensive individual studies of small towns and cities. Wholesale trade still seems to be the most promising factor to be studied in order to determine the degree of centrality exhibited by the various large cities. The value of per capita wholesale sales, however, has some defects as a measure, and the per capita retail sales value is not appropriate as a measure of centrality for large cities, for it is well known that the central place functions of large cities extend over a greater range than that covered by retail shoppers. What we should hope to find, then, is an index of urban centrality based on wholesale trade which will indicate the "degree of centrality" exhibited by any large city, whether it be a specialized, transportation, or central place type, and which is little affected by the regional and urban differences in per capita income.

A Qualitative Measure of Urban Centrality

By comparing the number of wholesale trade workers to the number of retail trade workers in large cities it may be that we will obtain a measure of centrality. It is assumed, although it is not strictly true, that it takes a constant number of wholesale workers to service a given number of retail workers. For the United States as a whole the ratio of wholesale workers to retail workers is 1 to 4.3; or, to express it differently, 18.8 per cent of the trade

[5] United States Bureau of the Census: *Statistical Abstract of the United States: 1959* (Washington: Government Printing Office, 1959), p. 311.

[6] United States Bureau of the Census: *County and City Data Book: 1956* (Washington: Government Printing Office, 1957), pp. 346–362. The term "standard metropolitan area" was replaced in 1959 by "standard metropolitan statistical area."

[7] See especially E. L. Ullman: "A Theory of Location for Cities," *Amer. Journ. of Soc.*, Vol. 46, 1940–1941, pp. 853–864.

workers (wholesale plus retail) are employed in wholesale trade.[8] If the figure is higher than 18.8 per cent for a city or area it is assumed that the wholesale workers are serving the needs of a population outside the city or area, and if the figure is lower than 18.8 per cent it is assumed that the city or area is making some of its wholesale purchases outside the city or area. In short, by using readily available United States census data we are attempting to obtain the same information that we could obtain by asking each wholesaler in a city what percentage of his trade was with customers outside the city.

Figure 1 presents the results obtained by the application of the wholesale-retail measure of centrality to the 56 standard metropolitan areas in the United States with a population exceeding 300,000. (See also Table I.) The size of the circles varies according to the population, and the shading varies according to the degree of centrality of the city, the lighter circles indicating a high centrality, darker ones a lower centrality. In short, this map shows the location, distribution, and size of the larger standard metropolitan areas and the relative amount of "outside business" handled by the wholesalers in each area.

Nineteen cities have a percentage exceeding 22.3 per cent (white circles) and are well scattered; no two cities in this class are close together except Ft. Worth and Dallas—which, in this respect at least, are apparently serving as a single city—and there is no clustering of high-ratio cities in the densely populated Northeast as there is of cities with low ratios. New York has the sixth highest ratio and because of its size has no competition from cities of similarly high ratios nearer than Boston, Richmond, Cleveland, and Rochester. Many of the cities in the northeast industrial belt have low ratios, including Dayton, Akron, Youngstown, Detroit, Wheeling, Allentown-Bethlehem-Easton, and Wilkes-Barre–Hazleton. At the bottom of the scale is Washington, which is probably the most economically dependent city of its size in the United States, despite its highly centralized political function. Outside of the manufacturing belt almost all the cities have very high values. Two exceptions are the specialized resort cities of San Diego and Miami. Obviously neither of these cities is well located to serve as a large central place, for their hinterlands are sharply limited, by water in both cases and a political boundary in the latter case.

Among the 56 standard metropolitan areas of over 300,000 population there appears to be no decrease in centrality with a decrease in population. In Figure 2 cities are arranged in order of their size, and the ratios are plotted on the abscissa. The range of values is as great at the high end of the scale as at the low end.

Another centrality index has been devised by the author, which is similar to the one just described, except that instead of being based on the number of wholesale and retail workers it is based on the dollar value of wholesale and retail sales. The results are very similar; the Spearman Formula yields a positive correlation of .83. Certain cities, however, deviate widely from one measure to the other and suggest an avenue of further research. The number of workers is likely to be a more reliable indicator, for "paper transactions," including various financial manipulations such as "futures" buying, may tend to inflate the wholesale sales values, where-

[8] Calculated from United States Bureau of the Census, *Seventeenth Census of the United States: 1950. Population*, Vol. 2 (Washington, D. C.: Government Printing Office, 1952).

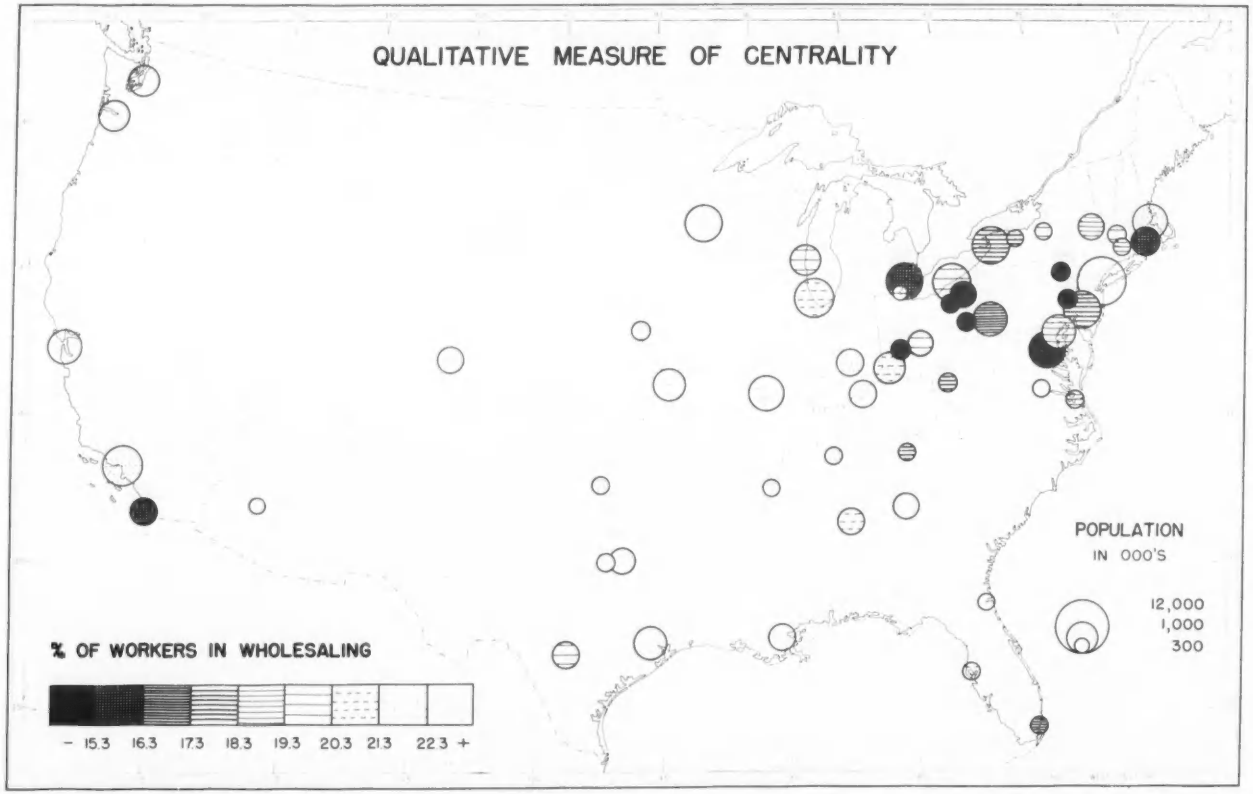


FIG. 1. Percentage of total trade workers (retail plus wholesale) employed in wholesale trade for each of the 56 largest standard metropolitan areas. The area of the circles varies approximately with the population of the standard metropolitan areas. Calculated from U. S. Bureau of the Census, *Seventeenth Census of the United States: 1950. Population*, Vol. 2 (Washington: Government Printing Office, 1952).

TABLE I

PERCENTAGE OF TOTAL TRADE WORKERS EMPLOYED IN WHOLESALE TRADE FOR EACH OF THE 56 LARGEST STANDARD METROPOLITAN AREAS

Omaha	25.9	Cleveland	20.2
Memphis	25.7	San Antonio	20.1
Minneapolis-St. Paul	25.3	Columbus	19.9
Dallas	25.0	Syracuse	19.6
New Orleans	24.9	Springfield-Holyoke	19.6
New York–Northeastern New Jersey	24.8	Milwaukee	19.6
Portland, Oregon	24.2	Toledo	19.3
Jacksonville	24.2	Norfolk-Portsmouth	19.2
Denver	23.7	Hartford	19.2
Houston	23.6	Albany-Schenectady-Troy	19.1
Atlanta	23.3	Baltimore	18.5
Richmond	23.2	Philadelphia	18.2
Seattle	23.1	Buffalo	17.9
San Francisco–Oakland	23.0	Rochester, New York	17.9
Phoenix	23.0	Charleston, West Virginia	17.7
St. Louis	22.9	Knoxville	17.6
Fort Worth	22.8	Pittsburgh	17.2
Louisville	22.4	Miami	17.0
Kansas City	22.3	Detroit	16.2
Oklahoma City	21.8	Providence	15.9
Boston	21.6	San Diego	15.5
Indianapolis	21.6	Dayton	15.0
Los Angeles	21.4	Allentown-Bethlehem-Easton	15.0
Nashville	21.3	Wilkes-Barre–Hazleton	14.4
Birmingham	21.2	Akron	14.4
Chicago	20.6	Youngstown	14.3
Tampa-St. Petersburg	20.5	Wheeling-Steubenville	13.5
Cincinnati	20.4	Washington	12.3

as the number of wholesale workers would scarcely be affected.

A QUANTITATIVE MEASURE OF CENTRALITY

The index of centrality which we have considered measures the relative amount of "outside business" handled by a city's wholesalers. Perhaps a more meaningful measure for the study of central places is of the absolute or quantitative extent of the "outside business" of a city. A large city with a low centrality may have more effect on a larger hinterland than would a small city with a high centrality index.

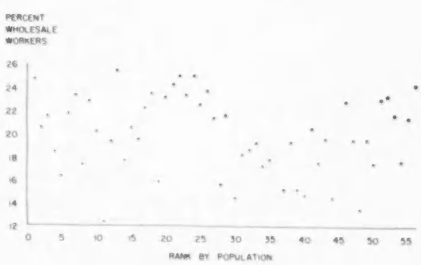


FIG. 2. Percentage of trade workers engaged in wholesale trade for 56 standard metropolitan areas arranged in order of size with the largest city to the left. Calculated from U. S. Bureau of the Census, *Seventeenth Census of the United States: 1950. Population*, Vol. 2 (Washington: Government Printing Office, 1952).

To achieve this measure it is first assumed, as before, that 18.8 wholesale workers are required for every 81.2 retail workers. A city with 18.8 per cent of its trade workers in the wholesale business is assumed to be self-sufficient, neither making any wholesale purchases from any other source nor making any wholesale sales to any other points; or, as would be more likely, the sales and purchases are evenly balanced. This theoretical number of wholesale workers (that is, 18.8 per cent of the total trade workers) has been calculated for each city, and the result has been compared with the actual number of wholesale workers in the city. New York has a positive difference of 68,101, which is

TABLE II

NUMBER OF WHOLESALE WORKERS IN EXCESS OF 18.8 PER CENT OF THE TOTAL NUMBER OF TRADE WORKERS FOR EACH OF THE 56 LARGEST STANDARD METROPOLITAN AREAS

New York–Northeastern New Jersey	68,101	Tampa–St. Petersburg	669
Los Angeles	10,242	Milwaukee	578
Chicago	8,556	San Antonio	566
San Francisco–Oakland	8,443	Columbus	508
Minneapolis–St. Paul	7,297	Syracuse	236
Boston	5,704	Toledo	179
St. Louis	5,668	Hartford	137
Dallas	4,316	Norfolk-Portsmouth	127
New Orleans	4,022	Albany-Schenectady-Troy	111
Houston	3,677	Charleston, West Virginia	−210
Portland	3,547	Knoxville	−268
Memphis	3,328	Baltimore	−293
Seattle	2,931	Rochester, New York	−342
Atlanta	2,846	Springfield-Holyoke	−360
Kansas City	2,838	Buffalo	−717
Denver	2,599	Miami	−972
Omaha	2,386	Wilkes-Barre–Hazleton	−1,040
Louisville	1,687	Allentown-Bethlehem-Easton	−1,078
Cleveland	1,685	Wheeling-Steubenville	−1,147
Jacksonville	1,619	Dayton	−1,167
Fort Worth	1,447	Akron	−1,256
Indianapolis	1,427	San Diego	−1,308
Richmond	1,411	Providence	−1,469
Cincinnati	1,297	Youngstown	−1,533
Phoenix	1,153	Philadelphia	−1,729
Oklahoma City	1,005	Pittsburgh	−2,442
Birmingham	988	Detroit	−5,549
Nashville	702	Washington	−6,760

taken to mean that 68,101 of New York's 280,294 wholesale workers are selling goods to places other than New York. Philadelphia has a negative difference of 1729, meaning (if our assumptions are correct) that 1729 wholesale workers located somewhere other than in Philadelphia are supplying the needs of the city. (See Table II.)

Figure 3 shows the results of this quantitative measure of centrality for the 56 standard metropolitan areas. The size of the circles varies according to the number of wholesale workers the city has as surplus (white circles) or the number in which the city is deficient (black circles). This is probably the most accurate indication of central places, for it is not distorted by the quantity of other specialized activities going on in a city or by the size of the city. The spacing of the central places is remarkably orderly; the largest places are more widely separated, and smaller places are closer together. Ft. Worth and Dallas are close together but again apparently serve as a single city; otherwise there is no case of "clustering" of central places as there is with industrial cities. Cities deficient in wholesale workers are almost exclusively specialized manufacturing cities located in the manufacturing belt, the two resort cities of San Diego and Miami being exceptions.

CONCLUSION

Cities can, and usually do, have several central place functions. It has been assumed in this study that the most valid single indicator of the extent of these functions is wholesale trade. It follows from this assumption that if a city's wholesalers are largely concerned with extra-city sales we would expect that its entertainment facilities, its professional and educational services, its medical facilities, and its newspaper sales would also be concerned largely with the hinterland. Such a city we would con-

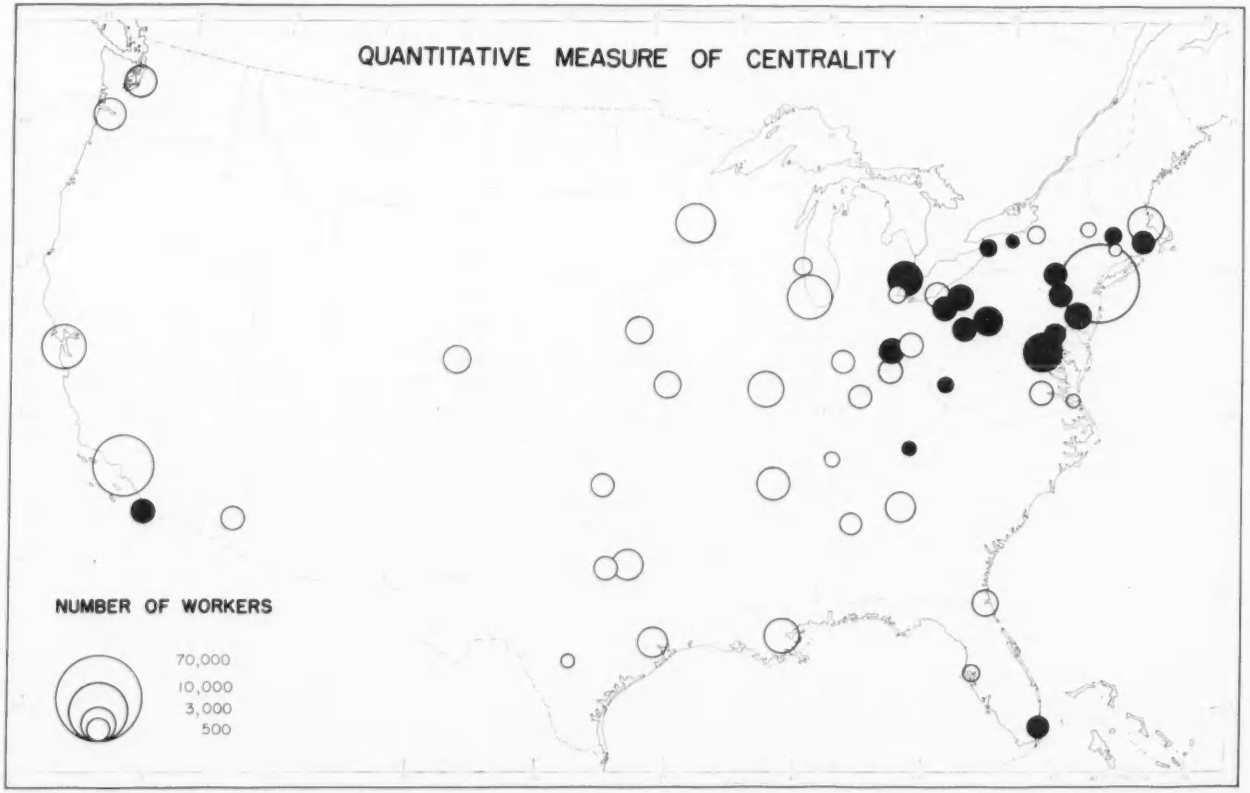


FIG. 3. Number of wholesale workers in excess of or less than 18.8 per cent of the total number of trade workers (retail plus wholesale) for each of the 56 largest standard metropolitan areas. White circles represent metropolitan areas in which the number of wholesale workers is in excess of 18.8 per cent of the total number of trade workers, black circles those areas in which it is less than 18.8 per cent. The area of the circles varies approximately with the number of workers above or below the 18.8 per cent. Calculated from U. S. Bureau of the Census, *Seventeenth Census of the United States: 1950. Population*, Vol. 2 (Washington: Government Printing Office, 1952).

sider as having a high degree of centrality. This is the significance of the assumption upon which the two measures of centrality proposed in this paper are based.

Only further empirical studies of American cities can validate these measures. However, the qualitative measure first discussed seems to hold promise as an aid to a further understanding and classification of urban centers, while the second measure should contribute to our understanding of the distribution and hierarchy of central places.

LOCATION AND RELOCATION OF A TREE CROP—ENGLISH WALNUTS IN CALIFORNIA

Kenneth Thompson

Dr. Thompson is Assistant Professor of Geography at the University of California, Davis.

THE walnut is by no means to be dismissed as a crop of trivial value. Indeed, it ranks as one of the more important tree crops in the world. Among the true dessert nuts, it ranks second, after the almond, in terms of world production value. The species most commonly cultivated is the English walnut (*Juglans regia*), also known as the Persian, Circassian, Madeira, European, French, or Italian walnut.[1] There are numerous varieties of English walnut with varied environmental adaptations and importantly different crop characteristics.

English walnuts have a wide distribution in the United States. Some grow as far north as upstate New York, but commercial production is virtually confined to Oregon and California, mainly the latter.[2] For several decades, English walnuts have been an important Cali-

[1] The so-called "English" walnut has spread far from its original habitat, which was not England but probably southwestern Asia. The Greek names applied to this walnut caused Pliny to infer that it originated in Persia, the best types being styled in Greek *Persicum* (Persian nut) and *basilicon* (nut of the king—the king being Basilicus of Persia). The earliest Chinese designation for the cultivated walnut is *hu t'ao* (peach of the Hu)—Hu being a general term for Central Asian peoples, particularly Iranians. A philological interpretation of a Chinese-Sanskrit name for *Juglans regia* in a twelfth century Buddhist dictionary indicates that in India the tree or fruit was suspected of Persian provenience. The common Sanskrit term for walnut (*akhota, aksota, aksosa*) is regarded by philologists as an Iranian loan word.

There is abundant evidence that *Juglans regia* is extensively naturally distributed from the Mediterranean through Iran and the Himalaya as far as southern China. Vavilov states that the "world's potential sources of Occidental orchard fruits are concentrated in the Near East, the native home of the . . . walnut. . . . The first orchards were undoubtedly located in the Near East." (N. I. Vavilov, "The Origin, Variation, Immunity and Breeding of Cultivated Plants," *Chronica Botanica*, Vol. 13, Nos. 1/6, 1949–1950, p. 35).

Other authorities state that the English walnut is "native from southeastern Europe to Himalaya and China," (*Trees, The Yearbook of Agriculture 1949*, Washington, D. C.: United States Department of Agriculture, 1949, p. 826) and "occurs from the Black Sea region across Asia Minor and Persia to northern India." (Albert F. Hill, *Economic Botany*, New York: McGraw-Hill Book Company, Inc., 1952, p. 114). And another authority locates the English walnut's origins somewhat more exactly as Asia Minor (Clarence A. Reed and John Davidson, *The Improved Nut Trees of North America and How to Grow Them*, New York: The Devin-Adair Company, 1954, p. 72). Numerous other references concur in an Asia Minor–Iran–Himalaya–China distribution of walnuts (including numerous citations in Berthold Laufer, *Sino-Iranica*, Chicago: Field Museum of Natural History, Publication 201, Vol. XV, No. 3, 1919, pp. 254–275). Despite this broad natural distribution it appears that the major cultivated varieties originated in Iran, and from there were transmitted to India, Central Asia, and China, and to Greece, Rome, and beyond. Such origins give historical justification for the alternative name "Persian walnut." (Except where otherwise cited, the preceding section of this footnote is based on the erudite, and elaborately documented, philological work of Laufer, *op. cit.*, pp. 254–275).

It is known that the species *Juglans regia* existed in England prior to 1562 and that specimens were brought to eastern North America by early colonists. These were called "English" walnuts to distinguish them from the native American black walnuts (William Henry Chandler, *Deciduous Orchards*, Philadelphia: Lea and Febiger, 1947, p. 388; W. W. Robbins and F. Ramaley, *Plants Useful to Man*, Philadelphia: P. Blakiston's Son & Co., Inc., 1933, p. 272). In modern times, the major English walnut producing nations are the United States, Italy, France, India, Iran, Turkey, Yugoslavia, and Syria. See data below:

[2] In 1937–1941, California produced 91.6 per cent of the English walnut crop in the United States. The California share increased to 92.2 per cent in 1948–1952, and to 93.8 per cent in 1955 (C. O. McCorkle, *A Statistical Picture of California's Agriculture* [Berkeley: University of California Agricultural Experiment Station, Extension Service, 1957], p. 24).

Estimated Commercial Production of English Walnuts in Specified Countries—average 1952–1956, annual 1954–1959

Country	*Average 1952–1956*	*1954*	*1955*	*1956*	*1957*	*1958*	*Preliminary 1959*
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*	*Short tons*
France	28,300	26,500	33,500	20,500	9,500	29,000	25,000
India	*	12,000	8,500	10,500	12,000	12,000	*
Iran**	6,300	7,100	6,800	4,400	7,400	***	***
Italy	23,200	12,500	29,000	39,000	13,000	25,000	28,500
Syria	4,600	4,400	3,300	2,200	4,400	2,200	***
Turkey	5,500	5,500	5,800	4,100	3,500	6,000	7,000
Yugoslavia	4,300	5,300	5,600	3,500	3,300	4,500	5,000
Foreign total	83,200	73,300	92,500	84,200	53,100	85,000	87,400
United States	73,500	75,400	77,400	71,800	66,600	88,700	61,700
Grand total	156,700	148,700	169,900	156,000	119,700	173,700	149,100

Source: *Foreign Agriculture Circular* (Washington, D. C.: United States Department of Agriculture, Foreign Agricultural Service, November 30, 1959), p. 1.

*Not available; 1954–1957 average of 11,000 tons used in totals.

**Iranian data on a March to March year.

***Not available; 1952–1956 average used in totals.

fornia crop. In 1958 the English walnut crop of the state was worth over $30 million, ranking after oranges and peaches as California's most valuable tree crop.[3]

This important crop, so strongly localized in California, has shown a steady increase in commercial significance during the last hundred years. Accompanying the expansion was a radical rearrangement of the main producing regions in California. This paper examines the development of the English walnut crop in California and, in particular, its early extreme localization and subsequent drastic relocation. The article is divided into six sections: climate and soil requirements; early development as a California crop; spread to central and northern California; modern production characteristics; outlook; and conclusion.

[3] California Crop and Livestock Reporting Service, Sacramento, California.

CLIMATE AND SOIL REQUIREMENTS

The general climatic requirements of the English walnut include an absence of late spring frosts (below 30° F.) and early fall frosts. Spring frost may be damaging to flowers, and new growth is susceptible to frost damage in both spring and fall.[4] When dormant, walnut trees can withstand fairly severe cold. Excessive summer heat (over 100° F.), unless mitigated by high humidity, may be harmful and cause "sunburn."[5] Unfavorable temperature does not kill the tree but may adversely affect yield. Sensitivity to temperature extremes depends on variety; many

[4] Many large and apparently flourishing English walnut trees in Britain produce good crops only in occasional years, because of recurrent frost damage, particularly in spring.

[5] Sun-damaged nuts become "blanks" if burned in June or July. If the injury occurs later, when the nuts are more nearly mature, the kernel may shrivel or discolor.

varieties, for maximum crop, even require winter chilling.

An annual precipitation of at least 20 to 30 inches is generally considered necessary for production of English walnuts without irrigation. With irrigation, water quality is important, for the tree is highly sensitive to alkaline salts. Walnut tree roots, penetrating at least six feet, require fairly deep soil. Good underdrainage is essential if disease is to be avoided.

Though large sections of California are well adapted to English walnuts, much of the state is unsuited to the crop for one reason or another. Thus, the extensive uplands are generally unsatisfactory because of late-spring and early-fall frost hazards. Major regions thereby excluded are virtually all of the Sierra Nevada, Cascade Range, Modoc Plateau, and Klamath Mountains, together with the higher sections of the Coast Ranges and other uplands. The hottest sections of the Central Valley (particularly the southern extremity), and the Mojave Desert and adjacent areas of southeastern California are also unsuited to walnut culture, mainly because of their extreme, dry summer heat. Other portions of the state are physically unadapted because irrigation water is insufficient or of low quality; slope is too steep for irrigation; soils are heavy adobe, alkaline, or shallow; or other local conditions prevent walnut production. This leaves, minor local circumstances apart, the valleys and low slopes of the Transverse and Peninsular ranges in the southern coastal region; the valleys and low slopes of the Coast Ranges south of about 39° N. latitude; most of the Central Valley, particularly the midsection; and the foothills of the western Sierra Nevada (Fig. 1).

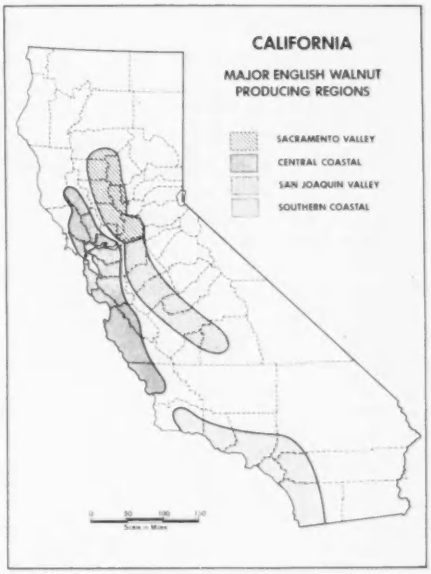


FIG. 1. California—major English walnut producing regions.

EARLY DEVELOPMENT AS A CALIFORNIA CROP

The first cultivation of English walnuts in the western United States was almost certainly by Franciscan monks who founded the California missions after 1769. Definite information is lacking, though there are some references to English walnut trees around the missions in early accounts. One of the earliest recorded observations of English walnuts in California was as follows:

> When I first arrived in Los Angeles, in December, 1854, there were numerous small bearing "English" walnut orchards and sundry isolated *large* trees which could not have been less than ten years old, and some of which must, I am confident, have been more than twenty-five (25) years old. In talking with Mr. Stephen C. Foster today, he fully corroborates my view, that the English walnut was first brought to Los Angeles, or to

> California, by the Missionary Fathers, or by individual laymen during the missionary era. Mr. Foster says that when he came here, in 1847, there were several large English walnut trees here, that he is certain were not less than twenty years old. One of these was on the old Pryor place, on Alameda Street, which I remember well, and another on the old Louis Vigne property, etc., which would make their planting extend back to 1827, or before. So I think it would without doubt, be historically true to say that the cultivation of the so-called "English" walnut was commenced in California as early as the first quarter of this century (and possibly still earlier) by the Mission Fathers, or under their patronage and encouragement.[6]

Another early source indicates that English walnuts were planted at Los Angeles in 1847. Thus:

> The increase of culture of fruit trees—and ornamental too—is remarkable. In 1847, probably were set out two hundred young walnut trees; only three bearing are remembered—one on the east side of Don Luis Vignes' place, one larger in the middle of the Pryor vineyard, another, very large, of Claudio Lopez. . . . In 1856, there were 648 walnut trees.[7]

According to Lelong,[8] the first commercial planting of English walnuts, outside of mission plantings, was made in 1843, on the Col. J. J. Warner ranch at San Diego. Other walnut orchards were planted between 1850 and 1865, including the Pryor, Vigne, Wolfskill, Dalton, Boyle, Shaw, Child, and Briswalter orchards at Los Angeles; the Temple orchard at La Merced Ranch in the San Gabriel Valley; the Heath orchard at Carpinteria; and the Wilson and Kewen orchards at San Gabriel—all in Los Angeles County. Of the 13 pioneer orchards on which there is definite information, only one is noted as located outside southern California: the "small" planting on the Frank E. Kellogg ranch at Calistoga, Napa County (Fig. 2).

Russell Heath, one of the abovementioned orchardists, recalls that:

> In 1858, the year I obtained my walnut seed of Mr. Wolfskill, of Los Angeles, I had no knowledge of walnuts being planted in this state, except those planted by the Mission Fathers. The trees from which my seed was taken were planted by the Franciscan Fathers. The Wolfskill place, in Los Angeles, was an old garden of the Mission. . . . Judging from the oldest trees I have at present, I think those walnut trees must have been over fifty years old in 1858. I made inquiry for walnut trees with the view of purchasing, and could not find any one who had tried their culture except the Mission Fathers.

FIG. 2. California counties.

[6] Letter from H. D. Barrows, a pioneer, February 29, 1896, quoted in Report of B. M. Lelong, Secretary and Chief Horticultural Officer, *Fifth Biennial Report of the State Board of Horticulture of the State of California, for 1895–96* (Sacramento: State Board of Horticulture of the State of California, 1896), p. 78. (Hereinafter reports of this organization referred to as *Report of the State Board of Horticulture*, various years.)

[7] J. J. Warner, Benjamin Hayes, and J. P. Widney, *An Historical Sketch of Los Angeles County, California* (Los Angeles: Louis Lewin & Co., 1876), p. 76.

[8] Lelong, *op. cit.*, p. 78.

> I was advised to plant walnuts by the Reverend Father Gonzalez, head of the Franciscan Missions, who resided for many years in Santa Barbara, from him I obtained much of its history taken from documents in his possession. The nuts were brought from Spain, first planted in Mexico, and taken from there to South America. The first planting in California was at San Diego; two at San Gabriel, Los Angeles County, three in Los Angeles. From my information, I think the Wolfskill place was one of the first planted in what is now the City of Los Angeles. . . . There was no record of the walnut having been planted north of the Mission of San Buenaventura, where I saw for the first time a walnut tree in 1852.[9]

While it seems certain that English walnut growing was introduced first in southern California—probably in the first part of the nineteenth century through the agency of the Franciscan missions in this section of the state—there is evidence to show that the crop was adopted fairly early elsewhere in California. Thus, in 1866 it was asserted that:

> . . . English walnuts are already produced in many parts of the state (California) in considerable quantities, and in quality equal to the imported.[10]

And, similarly, in 1867:

> Madeira nuts, or English walnuts, are cultivated in all portions of the state (California), being, however, most plentiful in the vicinity of Los Angeles, in the south coast district.[11]

That conditions suitable for English walnuts occur in much of California was suggested in 1874, in the statement that:

> . . . walnuts . . . are finding extensive cultivation in many localities, north as well as south of San Francisco, and that a uniform success had attended the culture.[12]

A similar opinion was again expressed in 1876, in a plea for diversification of agriculture in northern California, where it was declared that:

> . . . it has been proven that the orange, the almond, the English walnut, and pomegranite (*sic*), will grow almost spontaneously throughout this region (northern California).[13]

However, the advocacy, and certainly the actual planting, of English walnuts for northern California ranches was the work of a small minority in the early phase of the industry. Indeed, except with a very few dissidents, there was virtual unanimity in the conviction that the commercial cultivation of English walnuts was feasible only in the southern coastal counties. About the turn of the century, when the English walnut industry had grown to substantial proportions in California, the orthodox view was clearly stated in the following:

> The English walnut (*Juglans regia*) flourishes exceedingly well in many parts of the State, and where soil and climate are adapted to its growth is very remunerative to its grower. The tree makes remarkably thrifty growth in the fertile valleys of California both north and south but its favorite habitat is in the coast valleys of Southern California, where it reaches the perfection in both size and fertility. . . . Experience has taught us that the seedling English walnut (at this period commercial plantings were invariably from seed) is a failure in Northern California. It is not perfectly hardy in the inland counties, making a strong growth while young, which is cut back by an extra cold winter, and when it has attained a size suitable for bearing a crop it proves to be barren.[14]

Other expressions of this prevailing view are:

> . . . English walnuts . . . found to be

[9] Letter from Hon. Russell Heath, of Carpinteria, February 27, 1896. Quoted in *ibid.*, pp. 78–79.

[10] *Transactions of the California State Agricultural Society During the Year 1866* (Sacramento: Superintendent State of Printing, 1867), p. 35. (Hereinafter referred to as *Transactions*, various years.)

[11] *Transactions*, 1867, p. 526.

[12] *Transactions*, 1874, p. 4.

[13] *Transactions*, 1876, p. 82.

[14] *Report of the State Board of Horticulture*, 1891, pp. 84–85.

> at home in the State of California, especially in our rich valleys between the coast and the Coast Range Mountains (from context, this refers to the southern section of the state).[15]
>
> The walnut is extensively grown in the State, and is a tree yielding large returns. . . . The southern part of the State seems especially adapted to the grower of this variety of walnut.[16]
>
> The walnut has been growing in favor in the past few years, especially in the southern portion of the State, where sections are found in which soil and climate seem especially adapted to its growth.[17]
>
> Walnut growing is one of the specialties of Ventura County, and there the English walnut appears to reach its perfection.[18]
>
> The trees are wonderfully sure bearers, and appear to grow with great vigor most (*sic*) anywhere in Southern California.[19]
>
> . . . in the lower counties, where the tree (English walnut) finds a congenial home and most favorable conditions essentially required.[20]

General conviction that optimum conditions for English walnut growing were restricted to southern California was probably essentially sound at that time, considering that the popular early varieties were not hardy. However, whether soundly based or not, there is no doubt that acreage was at first very distinctly concentrated in the southern counties. It should be pointed out that there are no reliable detailed statistics on English walnut acreage and production before 1919, and that tracing the development of the crop depends on contemporary accounts and the rather dubious data extant.

The earliest (and certainly the least trustworthy) quantitative data on the California walnut crop date from 1866.[21] They consist of a listing, by counties, of numbers of walnut trees in the state, published by the California State Agricultural Society for various years. According to this source there were in 1866 only 17,271 trees in the entire state. And it was then customary to plant walnut trees about 40 feet apart—some 27 trees per acre if planted in squares—[22] which would mean that the 17,271 trees represented about 640 acres of walnuts. This same source of information reveals a fairly steady growth of walnut acreage in the state over the next few years (see Table 1). Limitations and inconsistencies in the data lead one to the conclusion that the walnut acreage was stated too low, which seems reasonable: not only was data collection machinery imperfect at this early date but growers would have been reluctant to supply complete information that could be used for tax purposes. Furthermore, the distribution of walnut acreage between counties is somewhat at variance with other, and more trustworthy, subjective evidence. With these limitations in mind, and assuming a fairly constant error, the *Transactions* figures should probably be taken only as signifying a substantial increase in California walnut acreage during the 1870's after modest beginnings in the 1850's and 1860's.

Although the early statistical material has only meager reliability and significance, there is, however, a considerable body of subjective evidence that permits approximate definition of the

[15] *Report of the State Board of Horticulture*, 1890, p. 158.
[16] *Report of the State Board of Horticulture*, 1892, p. 55.
[17] *Ibid.*, p. 364.
[18] *Ibid.*, p. 311.
[19] *Ibid.*, p. 141.
[20] *Report of the State Board of Horticulture* 1895–1896, p. 112.
[21] *Transactions*, 1866–67, pp. 560–561.
[22] There are several references that indicate a more or less standard spacing of walnut trees of 40 by 40 feet. These include:
a) Joseph Sexton, *Proceedings of the Ninth Fruit Growers' Convention of the State of California* (Sacramento: Superintendent of State Printing, 1888), p. 166.
b) A. Dorman, *Report of the State Board of Horticulture*, 1890, p. 161.
c) George W. Ford, *Report of the State Board of Horticulture*, 1890, p. 158.

early English walnut crop—in space if not in quantity. All of these sources indicate that, after the 1860's, the bulk of the walnut crop was harvested in Los Angeles, Santa Barbara, and San Bernardino counties.[23] Thus, in 1866 Hittell singled out the "enclosures" of Los Angeles as noteworthy for English walnut culture.[24]

The growth in importance, and localization, of the walnut crop is indicated by the following statement, dated 1885:

> . . . so well have our walnuts become known East, and over this entire coast, that they have become as staple an article of export as any other well known California product. The principal sources of supply as yet are Los Angeles (which then included the present Orange County), Santa Barbara, San Bernardino, and Ventura Counties, with perhaps a little preference among the trade for the nuts of the Los Nietos (Los Angeles County) section.[25]

That statement is confirmed in an ambitious, though unfortunately imperfect, "tree census" carried out in 1892 by the California State Board of Horticulture. This compilation recorded 14,912 acres of walnuts in the state.[26] Since the data for the "tree census" were collected by county assessors and had tax implications, it is reasonable to assume that it errs on the low side.

Thus, although the 1892 "tree census" is probably unreliable in quantitative terms, it clearly indicates southern California's early virtual monopoly in English walnut production. According to the 1892 statistics, about 93 per cent of total walnut acreage was in the southern counties of Ventura, Orange, Santa Barbara, Los Angeles, San Diego, San Luis Obispo, and San Bernardino (this latter included the area of Riverside County, formed from San Bernardino in 1893) (Fig. 3). It is also noteworthy that 8392 acres, 56 per cent of the total acreage, are listed as non-bearing, presumably indicating a considerable recent expansion of walnut acreage during the last five to eight years—the period required for trees to bear harvestable crops.

TABLE I

NUMBERS AND ACREAGES OF ENGLISH WALNUTS IN CALIFORNIA—1866–1874*

Year	*Number of trees*	*Approximate acreage†*
1866	17,271	640
1867–1868	15,614	580
1868–1869	25,888	960
1869–1870	39,438	1,460
1870–1871	58,300	2,160
1872	129,615	4,800
1873‡	109,380	4,050
1873‡	105,359	3,900
1874	138,673	5,140

Source: *Transactions of the California State Agricultural Society*, various years (Sacramento: Superintendent of State Printing).

*See cautionary observations in text.

†Computed on the assumption of trees spaced 40 feet apart in squares, giving 27 trees per acre.

‡Figures for 1873 are given in two separate volumes of the *Transactions* and differ slightly in total but drastically in detail.

A further expression of this situation is that:

> Although the planting of walnuts began in the northern part of the state almost as early as in the southern part, climatic conditions were not so favorable, and the southern counties are today almost the sole producers.[27]

SPREAD TO CENTRAL AND NORTHERN CALIFORNIA

The opinion that walnuts were a prerogative of southern California was strongly entrenched at the end of the

[23] Ventura County was formed in 1873 out of Santa Barbara County, and Orange County was formed in 1889 out of Los Angeles County.

[24] John S. Hittell, *Resources of California* (San Francisco: A. Roman and Company, 1866), p. 407.

[25] *Transactions*, 1885, p. 203.

[26] *Report of the State Board of Horticulture*, 1895–1896, p. 112.

[27] *Official Report of the Twenty-Sixth Fruit-Growers' Convention of the State of California* (Sacramento: Superintendent of State Printing, 1901), p. 139.

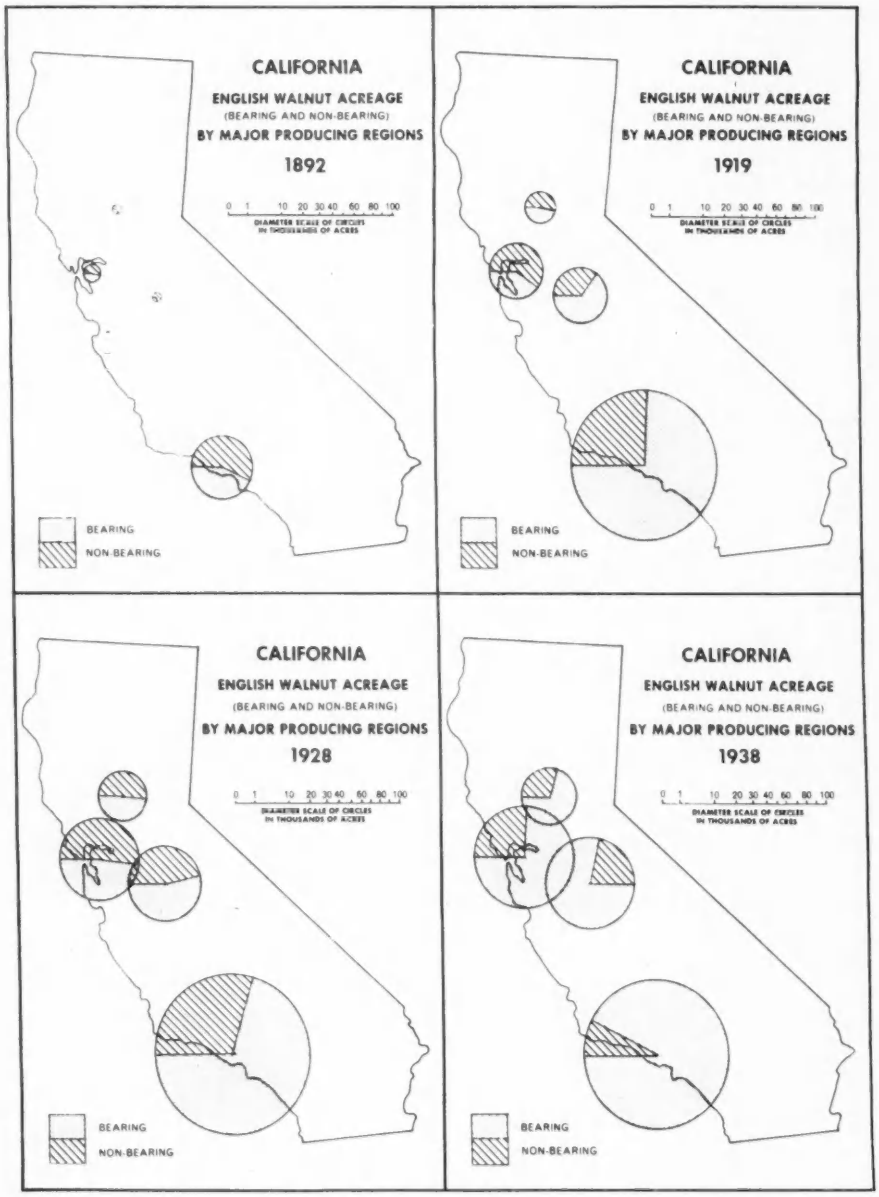


FIG. 3. California—English walnut acreage 1892, 1919, 1928, and 1938. Sources: *Report of the State Board of Horticulture*, 1895–1896 (Sacramento: State Board of Horticulture of the State of California, 1896). *Acreage Estimates California Fruit and Nut Crops 1919–1953—by counties*, Special Publication 275—Supplement (Sacramento: California Crop and Livestock Reporting Service, 1956).

nineteenth century. Only occasionally was it disputed. In 1890, a clear and well-reasoned opposition to the orthodox view was expressed by Felix Gillet, an important pioneer grower and breeder of walnuts from Nevada City, the only notable early producer outside the southern counties:

> Of all branches of horticulture so far experimented upon in California, I do not think there is one so little understood and so much under a cloud as walnut culture. This is due to several causes. Chief among them has been the undiscriminating propagation, all over the Pacific Coast for forty years, of the most delicate variety of walnut to be found anywhere, and known here under the name of the "Los Angeles" walnut, first started in the old mission of that name. Another cause that has had the effect of retarding the progress and spread of walnut culture throughout the state has been the stand taken by eminent walnut growers of Southern California, and their erroneous statements in papers read before horticultural societies and conventions, and the false impression made by them upon the public mind that walnut culture could not successfully be carried on except in a very small section of the state bordering the sea, in the counties of Los Angeles, Ventura, and Santa Barbara, and where to this day most of the walnut crop is grown.[28]

Gillet goes on to aver that, from his experience in Nevada City (Nevada County):

> . . . walnut culture can be successfully carried on on the whole Pacific Coast, provided we plant none but *hardy* kinds; in fact, the success of walnut culture in California lies exclusively in the hardiness of the kinds to be planted.[29]

Gillet spells out his objections to the preponderant "Los Angeles" walnut:

> . . . Constantly propagated from the seed for the last forty years, without any regard to the degeneration of the species, has three big defects that should make every one reject this variety as worthless, except where it is known to do well. First, it puts forth too early, from two to eight weeks before the foreign kinds, and is injured by late frosts in the spring three years out of four; second, it does not mature its wood well in the fall, and is nipped again by early frosts at that time; third, it blooms very irregularly, as the owners of such trees all over the state can very well ascertain in the spring at blooming time, the male flowers, or catkins, all dropping off before the female flowers, or nuts, had a chance to show themselves; consequently, the nuts, not being fertilized by the pollen or yellow dust secreted by the catkins, drop off after attaining the size of a large pea. In this way does that variety keep barren, or at least so unproductive that it has already induced many people throughout this State and Oregon to cut down their trees, some of them over thirty years old, they having come to the conclusion that the country was not adapted to the walnut, while it is that worthless kind, the Los Angeles (English) walnut, that is not adapted to our climate and that of Oregon.[30]

Gillet spoke presciently. The acceptance of new hardy varieties made possible the planting of walnuts in areas previously considered either too hot or too cold. The technique of grafting English walnuts on California black walnut rootstocks (now standard practice) was an innovation of this period that opened up the inland sections, with their excessively hot summers. The case for grafting was first made in 1887:

> . . . I believe this mode of grafting the English walnut on California stock deserves encouragement, as the trees are better adapted to the climate of the interior valley.[31]

With new varieties, techniques, and knowledge available, the way was cleared for breaking southern California's walnut growing monopoly. Soon afterward, disease became important in

[28] Felix Gillet, *Report of the State Board of Horticulture*, 1890, p. 162.
[29] *Ibid.*, p. 163.
[30] *Ibid.*, p. 163.
[31] *Report of the State Board of Horticulture*, 1887, p. 260.

promoting dispersal of walnut orchards. In the early decades the orchards were noted as remarkably disease-free and consistent in yield, but toward the end of the nineteenth century, areas of intense walnut growing began to suffer significantly from disease. Symptomatic was a note, in 1905, that:

> . . . the walnut blight was very serious throughout the walnut orchards of Los Angeles and Orange Counties, and did a great deal of damage during the season, cutting largely into the crop. It also extended its operations into new sections and appeared in Ventura and to some extent Santa Barbara counties for the first time . . . crop was not over 60 per cent of what was expected . . . also of poor quality, owing to the blight.[32]

Not surprisingly, the response to these circumstances was dispersal of the crop. This dispersal, still having to rely on subjective information, may be noted from this statement, in 1917:

> New walnut producing areas are being developed, and very heavy plantings are being undertaken in several sections, in the San Joaquin Valley and other valleys of the state, and probably one third of the plantings of the past season have been made north of the Tehachapi.[33]

The recent phase in the development of English walnuts as a major California crop must arbitrarily begin in 1919, the first year for which entirely reliable acreage and production data are available.

The total acreage devoted to English walnuts has been remarkably constant in recent decades. In 1919 the state contained 103,659 acres (bearing and non-bearing); in 1928, 146,656 acres; in 1938, 153,307 acres; in 1948, 150,468 acres; and in 1958, 153,525 acres. It has fluctuated from a low of 103,659 acres (1919) to a high of 153,861 acres (1936). As far as bearing trees only are concerned, the variations have been somewhat greater, from a low of 70,364 acres (1919) to a high of 129,876 acres (1939).[34]

The most drastic recent changes in the English walnut industry of California have to do with the location and yield of orchards. Thus, in 1919, 75.4 per cent of the state total acreage (bearing and non-bearing) was in the counties of the southern coastal region, south of the Tehachapi Mountains.[35] Practically all of the remainder, 24.2 per cent in fact, was in the counties making up the Central Valley and the mid-section of the Coast Ranges[36] (Fig. 3).

By 1928, a distinct northward shift of walnut-producing centers was apparent. The southern counties were still dominant, containing 66.3 per cent of

[32] *Report of the State Board of Horticulture*, 1905–1906, p. 30.

[33] *Statistical Report of the California State Board of Agriculture for the Year 1917* (Sacramento: Superintendent of State Printing, 1918), p. 171.

[34] *Acreage Estimates California Fruit and Nut Crops 1919–1953—by counties*, Special Publication 275—Supplement (Sacramento: California Crop and Livestock Reporting Service, 1956), pp. 220–225. *Acreage Estimates California Fruit and Nut Crops as of 1954, 1955,1956, 1957, and 1958* (Sacramento: California Crop and Livestock Reporting Service, various years). Hereinafter all acreages quoted are from these sources, unless otherwise stated.

[35] These consisted of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties. This group of counties has generally similar physical and agricultural characteristics, and composes a "crop reporting district" used for statistical reference by the California Crop and Livestock Reporting Service. Subsequent groupings of counties will form other "crop reporting districts."

[36] This included three crop reporting districts, ranked in order of importance: (1) the Central Coastal group, composed of Alameda, Contra Costa, Lake, Marin, Monterey, Napa, San Benito, San Luis Obispo, San Mateo, Santa Clara, Santa Cruz, and Sonoma counties; (2) the San Joaquin Valley group, composed of Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare counties; and (3) the Sacramento Valley group, composed of Butte, Colusa, Glenn, Sacramento, Solano, Sutter, Tehama, Yolo and Yuba counties. The 20 counties omitted from the previous listings contained only 991 acres (bearing and non-bearing), slightly less than 1 per cent of total state acreage, in 1919, and 2368 acres (bearing and non-bearing) or about 1.5 per cent of the total in 1958.

the total acreage, but the Central Coast Range region (14.9 per cent of total acreage), San Joaquin Valley (12.8 per cent), and Sacramento Valley (5.0 per cent) all increased in importance (Fig. 3).

The same trend is apparent in the data for 1938, when only 51.9 per cent of all acreage was in the southern group of counties. The share of the northern counties rose to 22.0 per cent for the Central Coastal region, 17.2 per cent for the San Joaquin Valley, and 7.1 per cent for the Sacramento Valley (Fig. 3).

Another decade produced no change in trend. In 1948 only 34.8 per cent of the acreage was in the southern counties, whereas the share of the Central Coastal region had risen to 26.3 per cent and the respective shares of the San Joaquin and Sacramento Valleys had risen to 26.1 and 11.5 per cent. In 1958 (the latest year for which statistics are available) the acreage in the southern counties had sunk to only 15.2 per cent, whereas the San Joaquin Valley area had achieved dominance, with 35.8 per cent of the total state acreage. The Central Coastal area and Sacramento Valley respectively contained 29.6 and 17.9 per cent of the total acreage (Figs. 4 and 5).

These figures show a radical rearrangement in the pattern of walnut production within the state. In less than 40 years the production centers moved from the Los Angeles area to north-central California. It should be noted that these percentage changes occurred on a fairly constant base. At first, the migration was relatively slow although steady. After the late 1930's and through the 1940's the rate of movement was much accelerated. In recent years the movement continues at a somewhat slower, but still fairly steady, rate (Fig. 6).

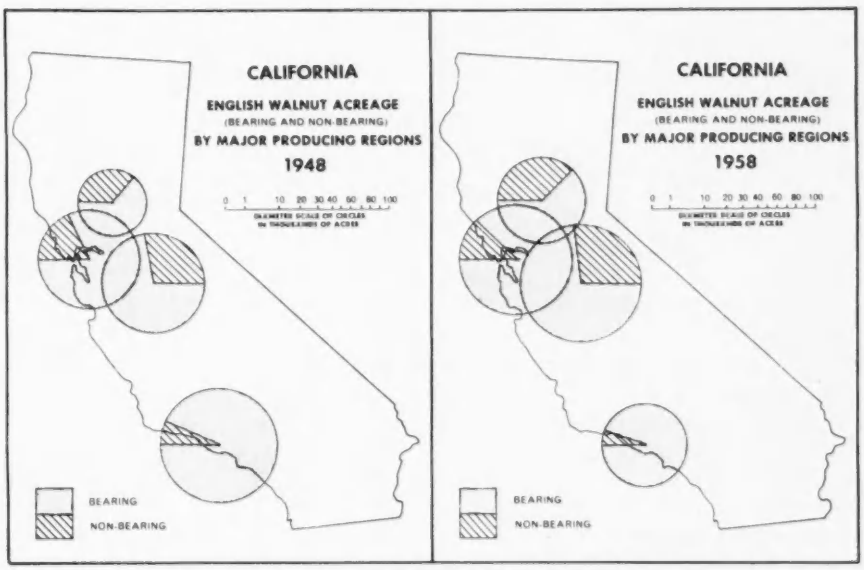


FIG. 4. California—English walnut acreage 1948 and 1958. Sources: *Acreage Estimates California Fruit and Nut Crops 1919–1953—by counties*, Special Publication 275—Supplement (Sacramento: California Crop and Livestock Reporting Service, 1956). *Acreage Estimates California Fruit and Nut Crops as of 1958* (Sacramento: California Crop and Livestock Reporting Service, 1959).

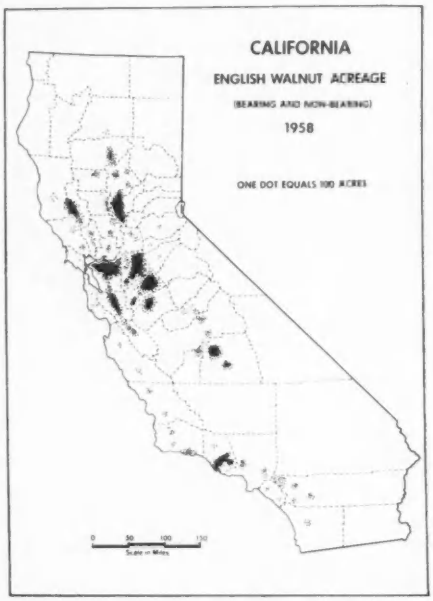


FIG. 5. California—English walnut acreage 1958. Source: *Acreage Estimates California Fruit and Nut Crops as of 1958* (Sacramento: California Crop and Livestock Reporting Service, 1959).

The northward shift from southern California has been caused and sustained by a number of more or less unrelated factors. Of outstanding importance is the tremendous urbanization of the former southern walnut-growing regions. Increasing diversion of land to residential and industrial use has been at the expense of perennial crop acreage. Cropland of all types, of course, has been converted from agricultural to urban uses, but there has actually been something of a selective attack on walnut orchards, which seem to present an irresistible invitation to the residential subdivider. They generally offer level land with large, handsome shade trees and good access roads—all most desirable for a housing development.[37] In consequence, the premium that high-price walnut land commands from subdividers has doomed many orchards to commercial extinction or relocation.

Figure 7 shows the growth of subdividing and the coincident decline of English walnut acreage in southern California counties. This comparison alone proves little, but it generally supports the clearly observable phenomenon that subdivision has been highly destructive of commercial walnut acreage in southern California. Given the limited area of fairly level land in the nondesert sections of these southern counties, the competition between perennial-crop and urban land use becomes more acute than is suggested by the actual area of land urbanized.

There are numerous other negative aspects, as far as the English walnut crop is concerned, of urbanization of southern California. Growth of urban population has worsened crop damage from air pollution, produced competition from more profitable crops, and led to some crop losses through theft and vandalism. Large-scale freeway construction has not only consumed much agricultural land but has often made local movement difficult for the farmer. The heavier (and restricted) traffic of the freeways and their limited access, make it difficult to move farm machinery. Growth of urban population has also been accompanied by increased draft on underground water supplies, leading to the disruption of irrigation and drainage systems. The residential population of a farming area is liable to object to some normal farm operations, such as spraying. Another very impor-

[37] So many walnut orchards have been subdivided that popular gardening magazines offer advice on the care of mature walnut trees that remain in such developments. Ironically, it might be added that such English walnut trees do not flourish without special attention. The black walnut rootstock is highly susceptible to crown rot disease in garden lawn locations. Tree-wreckers do a thriving business in subdivisions that have been established several years in former walnut orchards.

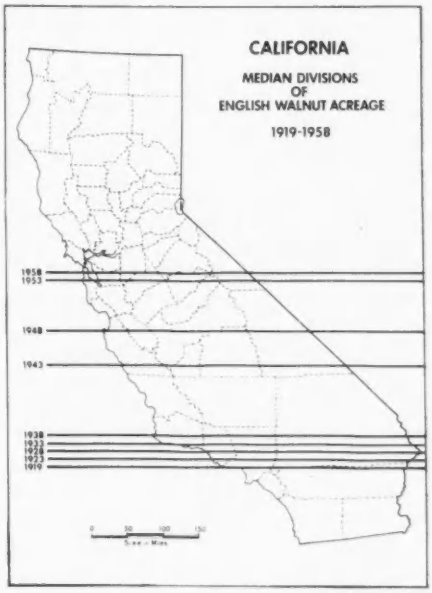


FIG. 6. California—Median Divisions of English Walnut Acreage 1919–1958. Sources: *Acreage Estimates California Fruit and Nut Crops 1919–1953—by counties*, Special Publication 275—Supplement (Sacramento: California Crop and Livestock Reporting Service, 1956). *Acreage Estimates California Fruit and Nut Crops as of 1958* (Sacramento: California Crop and Livestock Reporting Service, 1959).

tant aspect of the urbanization of farm land is the increase in tax liability usually resulting. Greater population density increases need for public services, which have to be supported by increased taxes. In addition, the assessed value of farm property increases because of non-farm competition for land.[38]

While these strong external forces have acted to displace English walnut cultivation, some internal forces have also been exerted. Thus, the commercial walnut orchards of southern California have generally been established without the benefit of modern research on walnut cultivation. Many are poorly sited, or at least are not in the best possible locations. Part of the intrastate movement of walnuts can certainly be explained in terms of a search for more nearly optimum conditions of production. Contrary to earlier opinion, the conditions in northern California are now held to be superior to those in the southern part of the state. Greater winter chilling in the north, with the hardy varieties, is believed by many growers to be advantageous. Southern

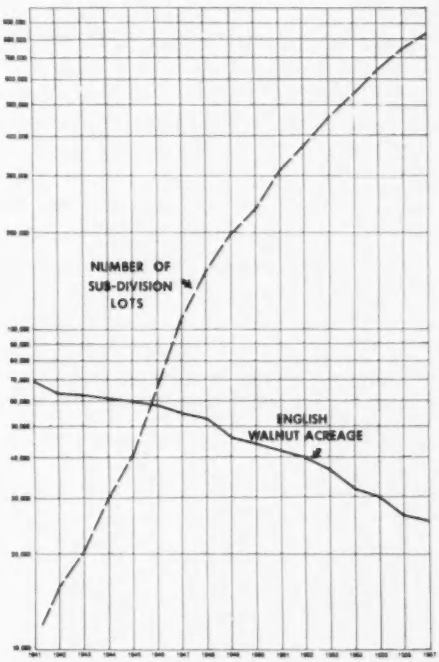


FIG. 7. English walnut acreage compared with number of subdivision lots in Southern California Counties (Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara, and Ventura counties), 1941–1957. Sources: *Acreage Estimates California Fruit and Nut Crops 1919–1953—by counties*, Special Publication 275—Supplement (Sacramento: California Crop and Livestock Reporting Service, 1956). *Acreage Estimates California Fruit and Nut Crops as of 1958* (Sacramento: California Crop and Livestock Reporting Service, 1959). Communication from State of California, Division of Real Estate, Sacramento, 1958.

[38] For more detailed discussion of some of these problems, see Howard F. Gregor: "Urban Pressures on California Land," *Land Economics*, Vol. 33, November, 1957, pp. 311–325.

orchards have also become decadent and particularly subject to blight, insect pests, and fungus trouble of various types.

Another advantage the north offers is greater irrigation possibilities. The precise advantages that irrigation affords English walnuts are not clear. Some successful orchards are operated entirely without irrigation. However, it is known that Oregon growers of walnuts have average yields far below those of California. Since most of the Oregon walnuts are produced in the fertile Willamette Valley the substantial difference in yields is presumably due not to fertility differences but to climate or cultivation differences. One major difference is that irrigation is widespread in California. Increasing desire on the part of California walnut orchardists to secure more easily and cheaply the benefits of irrigation have been a potent influence in causing northward migration of the crop. Northern and central California, with more abundant, superior-quality, and generally less expensive irrigation water supplies than the south, offer obvious attractions to the progressive walnut grower.

MODERN PRODUCTION CHARACTERISTICS

English walnut orchards tend to be small in California. In 1954, the state total of 121,927 acres (bearing and nonbearing trees) was divided among 18,778 producers—an average of only 6.5 acres per grower.[39] However, this average figure is even less meaningful than such generalizations usually are, because the crop is produced by many small-scale and part-time growers as well as in large, thoroughly commercial orchards.[40] Another indication of the small-sized production units is that the Diamond Walnut Growers, Inc., an association marketing over 70 per cent of the California crop, has over 9000 members.[41]

Many of these small producers of English walnuts have only secondary or minor interest in the crop. Numerous retired persons, city commuters, and ranchers primarily engaged in other forms of agriculture, have a small acreage of walnuts. English walnuts are well suited to the small-scale and part-time orchardists. They are one of the easier tree crops to care for; the crop is non-perishable, facilitating harvesting and marketing; and prices have been relatively stable in recent years.

Two main types of walnut plantings may be recognized—those in orchards and those along road or field sides. Most important are orchards, which usually contain multiple rows of trees spaced 50–60 feet apart. Road or field-side plantings consist of single lines of trees, generally spaced more closely than orchard plantings. Plantings of this last type use space and even irrigation water that might otherwise be largely wasted. They may also serve as windbreaks and be considered aesthetically desirable. Nowadays, trees grafted on black walnut rootstocks, not seedlings, are planted because of their tolerance of oak root fungus.

In California, the concentration of annual precipitation in the winter season, with little in the growing season, has led to the widespread irrigation. The large majority of English walnut orchards are now irrigated. Usually the trees receive about three deep irrigations annually. Although English wal-

[39] *United States Census of Agriculture: 1954*, Vol. 1, Part 33, California (Washington, D. C.: U. S. Department of Commerce, 1956), p. 38. This does not include data for farmers with less than 20 trees.

[40] In the 1950 U. S. Census of Agriculture, when the 20 tree minimum was not applied, there were listed 26,796 producers with a total of 123,006 acres—an average of 4.6 acres per grower.

[41] J. H. Bryce: "Acres of Diamonds," *Western Canner and Packer*, Vol. 49, No. 3 (March, 1957), p. 22.

nuts are not considered a demanding crop, some upkeep is necessary. Most has to be done in the early years, when the tree must be trained and pruned. The orchards should be cultivated at least once a year, and irrigation ditches, dikes, and basins have to be prepared. It is also desirable to spray the trees against such pests as walnut blight, aphids, codling moth, caterpillars, and scale insects.

Some orchardists use a cover crop such as clover, mustard, or vetch to promote good physical condition in the soil so that it will take water and to maintain soil fertility. Because English walnuts take a long time to reach maturity, intercropping may be practiced. Beans, tomatoes, melons, and peppers are fairly common in young orchards. Peaches, prunes, almonds, and apricots may be planted temporarily between young walnut trees. Another practice is to use additional walnuts as interplants.[1] After 6–12 years it becomes necessary to remove the temporary trees, but they provide some return from the land while walnuts are yielding little or no crop. The English walnut lends itself to intercropping since it is deciduous and one of the last trees to come into leaf, causing a minimum of shade for spring crops. Even in leaf, a walnut tree usually does not cast dense shade on the ground, since pruning is performed to keep an open branch pattern.[42]

Some varieties of English walnut bear harvestable crops after only five years. Others require seven or eight years before producing worthwhile crops. However, crop production is not full until the trees are 12 to 16 years old.[43] Walnut trees continue to bear for a long time. Some highly productive California orchards are 50 to 60 years old.

The walnut crop in California is usually harvested by shaking or knocking the nuts off trees.[44] This results in a peak labor demand, generally involving temporary help. Hulling, washing, drying, and bleaching are the next steps preparatory to marketing.

Only in recent years have the principles of scientific walnut growing been formulated. The application of these principles has resulted in an enormous increase in yields. During the 1920's the average yield was 0.349 short tons per bearing acre;[45] in the 1950's the average yield rose to 0.557 tons.[46]

This increase in yields is due to the greater size of trees (with a higher proportion of trees at full-bearing development), and to the use of superior varieties that yield more abundantly and consistently. The increase can also be partly attributed to better cultivation practices such as improved disease and pest control, more general application of fertilizers, and wider use of irrigation. Also highly important in contributing to yield increase has been the shift from the low-producing orchards of southern California to higher-yielding centers in the north.[47] Total acreage has fluctuated relatively slightly since World War I, and has actually declined since World War II, but production has increased substantially in recent years. Thus, between 1919 and 1955, bearing acreage increased about

[42] However, intercropping is much less in California than in some foreign walnut-growing regions. The extensive walnut orchards of Italy tend to be thoroughly used for intercropping with vegetable and other crops.

[43] Chandler, *op. cit.*, p. 391.

[44] In Oregon the general practice is to allow the nuts to fall from the trees when the hulls split.

[45] *California Fruit and Nut Crops 1909–1955*, Special Publication 261 (Sacramento: California Crop and Livestock Reporting Service, 1956), p. 102.

[46] *Ibid.*, p. 102.

[47] Ralph G. Rush: "Walnut Acreage and Trends," *Diamond Walnut News*, Vol. 40, No. 3 (May, 1958), p. 22.

62 per cent while production rose about 133 per cent.

OUTLOOK

The northward movement of English walnut production in California has been clear and continuous since 1919, the earliest date for which reliable data are available. Southern acreage declined drastically while the northern increased steadily. This tendency will probably continue because the factors inducing relocation are unlikely to change substantially in the foreseeable future.

In the short run, orchards will continue the tendency to northward migration because the emphasis on new plantings, reflected in the acreage of non-bearing trees, is overwhelmingly in the northern rather than the southern producing regions.[48] In 1958, only 3.9 per cent of non-bearing acreage was south of the Tehachapi Mountains. The main concentration of non-bearing acreage is now in the lower San Joaquin Valley counties. Thus, barring feverish new planting, the southern counties will continue to decline in acreage.

Actually, the relative gain in importance of the northern walnut producing districts is likely to be even greater than the mere acreage figures suggest. This will be due to three major factors. Firstly, the trees of the northern orchards tend to be at the highly productive stage of early maturity since much of the acreage was planted during recent years. Secondly, the northern trees are generally high yielding because of varietal selection, more fertile soils, and possibly more effective irrigation practices. Thirdly, much of the northern acreage is still classed as non-bearing and is yet to come into production.[49]

CONCLUSION

The migration of crop production due to changed environment—physical or institutional—or in search of superior conditions is something of a geographical commonplace. Perhaps because of its unusually rapid development, California affords many examples of drastic changes in the pattern of crop production. For example, in the Central Valley, formerly important crops such as wheat have dwindled in importance, whereas crops like rice, milo, potatoes, corn, tomatoes, and cotton have appeared or greatly expanded their acreage. Crop production regions have been relocated: citrus growing has moved outward from the Los Angeles area, prunes have dispersed from the Santa Clara Valley, and English walnuts have migrated northward from southern California.

The movement of the English walnut production centers within California is remarkable for both its completeness and rapidity. As recently as 1928, some 66.3 per cent of the total walnut acreage in the state was in the southern counties. Progressive northward migration of walnut growing has reduced the acreage of the southern counties to only 15.2 per cent (1958) of the state total. All this occurred while total acreage in the state remained almost constant.

Such a far-reaching relocation of any crop is remarkable enough, but is even more remarkable when a perennial crop is involved, particularly one that takes as long to mature as do English walnuts. Such crops represent a heavy investment

[48] The continuing rapid urbanization of farm land in parts of southern California must have produced negative attitudes to perennial crops. In the face of an irresistible spread of urban growth, farmers will select annual rather than perennial crops, which have a considerable time lag before reaching maturity. This type of thinking, and its reverse in other parts of the state, is undoubtedly an ingredient of the situation.

[49] To illustrate this point, specific mention may be made of the San Joaquin and Sacramento Valley regions. There, 37.1 per cent and 27.4 per cent, respectively, of walnut acreage were classed as non-bearing in 1958.

in money and time. Growers are reluctant to abandon orchards, once established, and tend to make the best of the situation, recovering what they can from their expenditure by keeping in production.

Besides this inherent tendency to immobility, other factors militate against the migration of tree crops. A suitable labor pool becomes established, and hauling, storage, processing, and marketing facilities evolve—all reinforcing the immobility of the orchard.[50] In the California walnut industry, however, these inertial elements have been offset by potent forces making for relocation. Helping overcome these strong inertial influences has been the heavy urbanization of old established walnut-producing districts in southern California. High land prices for urban uses have encouraged growers to sell their orchards for residential subdivisions and industrial sites.

Despite the urbanization of southern walnut orchards, the total state acreage devoted to the crop has held steady for the past 30 years. This over-all stability has been achieved by much new planting, mainly in north-central California. Here there is relative freedom from negative urban pressures, more abundant and less costly irrigation water, cheaper land, less disease, and, where a fresh start with new, superior varieties is possible, conditions now considered more generally favorable to the crop.

As the centers of walnut production moved northward, service and other facilities tended to be drawn along. Notable among these was the facility of Diamond Walnut Growers, Inc., an association which processes and markets most of the California walnut crop. This was formerly nodally located in Los Angeles, once in the heart of the main producing districts but now at the extreme southern fringe. The illogical location was corrected in 1956, when a new installation was opened at Stockton.[51]

Thus, despite the potent influences making for immobility, or at least slow adjustment, the California English walnut industry has relocated drastically in recent decades. The industry has moved from its historic centers in the south to new production districts in the north, at the same time vastly increasing output from an almost unchanged total acreage of orchard. The completeness and celerity with which this tree crop has been relocated speaks eloquently for the dynamism and opportunism characteristic of California agriculture.

[50] England affords many striking examples of the immobility of tree crops. English orchards (mainly deciduous fruits) are concentrated in a few localities and are often of considerable antiquity. One authority has stated (L. Dudley Stamp, *The Land of Britain, Its Use and Misuse*, [London: Longmans, Green & Co., 1948], p. 124) that a very large proportion of English commercial orchards are badly sited. Even so, their inertia is such that they continue production from their traditional centers, with little apparent effort to relocate according to the principles of scientific production. The price paid for this inflexibility is great annual fluctuation in crop yields, which produces a national dependence on imported supplies that, under more rational production techniques, might be grown domestically.

ACKNOWLEDGMENT

The author is indebted to Eugene F. Serr, Lecturer in Pomology, University of California, Davis, for reading the manuscript and offering valuable suggestions.

[51] The new multimillion dollar Diamond Walnut Growers headquarters was located at Stockton because it lies near the center of California walnut production. Stockton has other advantages: it is a transportation center (with deep water port facilities) and has a suitable labor supply, including seasonal workers.

THE CONCORD GRAPE INDUSTRY OF THE CHAUTAUQUA-ERIE AREA

Richard E. Dahlberg

Dr. Dahlberg is Assistant Professor of Geography at the University of California, Los Angeles. The present study is based largely upon his dissertation for the University of Wisconsin.

THE Chautauqua-Erie grape area is located along the southeastern shore of Lake Erie astride the New York–Pennsylvania border (Fig. 1). Stretching along the lake for about 55 miles, this nearly linear strip of vineyards is known locally as the "Grape Belt." Through this constricted section of the lake plain of Chautauqua County, New York, and Erie County, Pennsylvania, pass three major highways and the New York Central and Nickel Plate railroads. The Chautauqua-Erie area is bounded along its entire length by the Allegheny Escarpment and extends southwest as far as the Erie urban area and northeast to the Cattaraugus Indian Reservation. In quantitative terms the district can be defined approximately by an isopleth enclosing areas with over 5 per cent of the land in grapevines. Thus defined, the Chautauqua-Erie area occupies about 200 square miles.

The Chautauqua-Erie area is distinct from the other commercial districts producing native-American grapes in several respects. The relatively great importance of viticulture in the agricultural enterprise structure of this area is shown clearly on the maps of American orchard and vineyard regions prepared by Olmstead.[1] On these maps the Chautauqua-Erie area appears as one of two deciduous fruit areas in which vineyards strongly dominate the orchard-vineyard association. Among the non-European vineyard areas on the North American continent the Chautauqua-Erie area ranks second to none. The persistent predominance of the Concord variety (*Vitis labrusca*) has been one of the most distinctive features of the Chautauqua-Erie industry for several decades. At present Concords comprise over 95 per cent of the total grape acreage. Another distinctive feature of the Chautauqua-Erie industry is the dominance of the unfermented grape juice processing plants in the marketing structure. Virtually all of the Chautauqua-Erie Concords are processed into unfermented grape juice as well as various secondary products such as jellies, soft drinks, and Kosher wines. This area with the greatest concentration of grape processing plants in the United States is also the heart of the unfermented grape juice industry in America.

This paper will analyze the salient geographic features of the Chautauqua-Erie area and industry in three sections. The first section will discuss the physical features of the area chiefly as they relate to the presence of the grape industry in the Chautauqua-Erie area, to the areal extent of the industry, and to the internal spatial arrangements of the in-

[1] Clarence W. Olmstead: "American Orchard and Vineyard Regions," *Econ. Geog.*, Vol. 32, 1956, pp. 189–236.

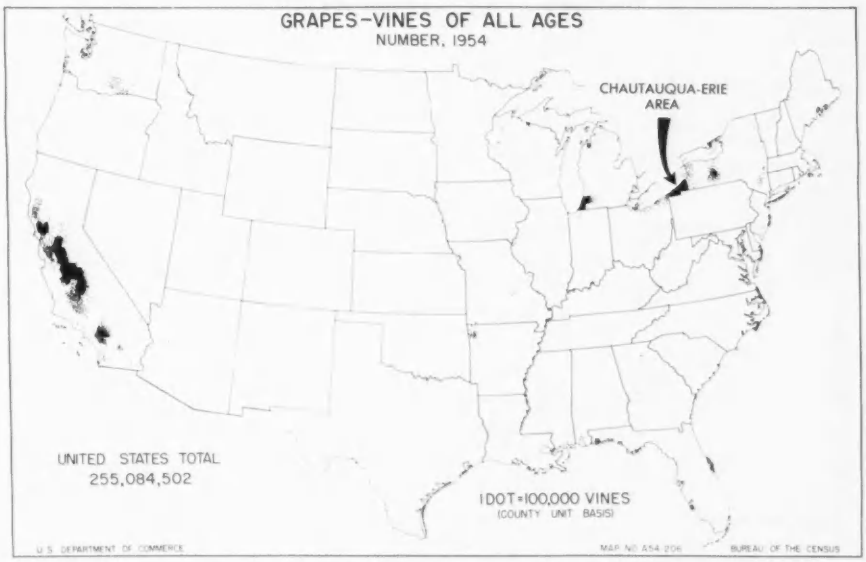


FIG. 1. Grapevines of all ages in United States, 1954. (Base map from U. S. Bureau of the Census.)

dustry. Methods of producing grapes will be described as well as the distributional arrangements of grapevines in a second section. A description of the morphological features of vineyards and farms producing grapes completes this section. The last section of the paper deals with marketing. There the antecedents of the present market outlets for Chautauqua-Erie grapes will be reviewed briefly, and special emphasis placed upon the spatial structure of the Chautauqua-Erie processing industry. A report on vertical integration in the Chautauqua-Erie industry concludes the section on marketing.

PHYSICAL CHARACTER OF THE AREA

In this first section the general features of climate, terrain, and soils which are related to the geography of the Chautauqua-Erie grape industry will be briefly analyzed.

Climate

The Chautauqua-Erie area is one of several fruit districts which depend upon the climatic benefits derived from a windward position on a Great Lakes' shore. The position of the Chautauqua-Erie area is somewhat analogous to that of other commercial vineyard districts within a narrow band of latitude which hug the shores of the Great Lakes and other smaller water bodies in northeastern United States. The area benefits from a shore site athwart lake winds as well as from a favorable arrangement of slopes.

Such a position provides the area with what might be called a "lacustrine climate," lacking the extremes otherwise inherent in a continental location. In spring the cool waters of Lake Erie reduce air temperatures and effectively retard blossoming until the danger of frost is lessened. On the other hand, in autumn warm lake waters modify air temperatures and help to delay frosts until late October. The position of the Chautauqua-Erie area towards the eastern end of Lake Erie serves to augment

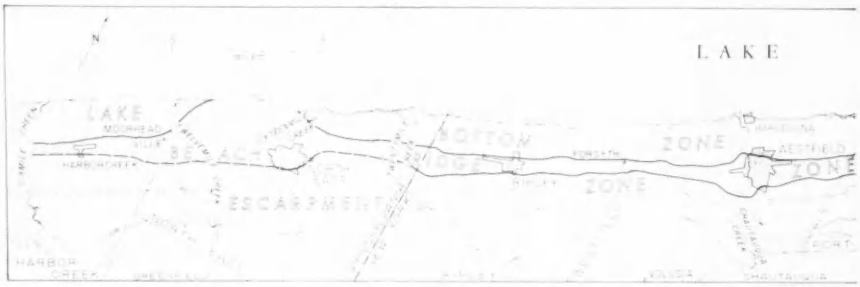


FIG. 2. General location map of Chautauqua-Erie

these modifications, the northeasterly drift of ice and cold water delaying the arrival of spring.[2] The frost-free period averages slightly over 170 days in this section of the Lake Erie plain. The length of this period drops to about 150 days on near-by sections of the plateau interior and to considerably less than that somewhat farther inland.

The boldness of the Allegheny Escarpment and its proximity to the lake in this area are of special climatic significance. The lake is an immense settling basin for cold air, and the arrangement of this escarpment, rising several hundred feet above the narrow, gently sloping lake plain, is especially favorable for air drainage. Of further significance is the nocturnal convectional circulation described by Haskins in a study of fruit sites along the Erie shore of Ohio.[3] This circulation is induced on cold nights by a temperature contrast between relatively warm lake waters and cooler adjacent land surfaces. The well-developed circulation of air in this area keeps vine foliage and grapes dry, thus largely deterring fungous diseases.

[2] Paul C. Morrison: "Viticulture in Ohio," *Econ. Geog.*, Vol. 12, 1936, p. 77.

[3] Glenn Haskins: "Orchard Sites and Frosts," *Amer. Fruit Grower*, Vol. 70, Oct. 1950, pp. 11, 20. See also F. G. Haskins: "A Study of Fruit Sites in Northeastern Ohio from Standpoint of Frost Damage," *Proceedings of the Ohio State Horticultural Society for 1950*, pp. 80–91.

As a consequence of the foregoing factors of position and site a climate results which a century of commercial grape production has revealed to be favorable for certain varieties of native-American grapes, especially the Concord.

Terrain

The Chautauqua-Erie section of the Lake Erie plain is relatively narrow, averaging only slightly more than three miles in width though varying from less than two to more than five miles (Fig. 2). Inclined gently towards the lake about 100 feet per mile, or slightly under 2 per cent, this narrow plain is separated from the lake's edge by a nearly continuous cliff, averaging over 50 feet in height and reaching a maximum height of over 170 feet in one area.

Bordering the lake plain along its landward southeastern edge is the Allegheny Escarpment. From the 900-foot contour which generally marks the inland edge of the lake plain, the escarpment rises some 500 to 700 feet within a distance of two to three miles. The grape area not only occupies the lake plain but extends up the escarpment face to about the 1100-foot contour, thus falling a few hundred feet short of the Allegheny Plateau surface, whose elevation varies from 1500 to about 2000 feet in the area.

The Chautauqua-Erie area is under-

area showing selected contours and soil zones.

lain by relatively flat-lying Paleozoic shales thinly mantled with glacial debris and pro-glacial lacustrine sediments.

On the basis of surface configuration and underlying materials the area can be divided lengthwise into three nearly linear zones (Fig. 2). The face of the Allegheny Escarpment comprises one zone which will be referred to as the escarpment zone. The lacustrine plain includes an inner beach ridge zone and an outer lake bottom zone. The beach ridge zone, lying at the foot of the escarpment, embraces the beach ridges and bars of at least two pro-glacial lakes. From the base of the lower beach ridge, an elevated pro-glacial lake bottom extends to the top of the wave-cut cliff bordering Lake Erie.

Soils

Although the combination of terrain and climatic elements establishes areal limits to commercial grape culture in the Chautauqua-Erie area, the pattern of soils is the single most important factor related to the internal spatial distribution of grapevines. Soils of the area differ widely in terms of their suitability for grape production, and these differences are mirrored in the distributional pattern of grapevines. The best soil for vineyards appears to be a fertile, well drained, deep, sandy or gravelly loam with a subsoil free from layers of clay which might impede drainage and restrict the depth of rooting. A soil underlain by a highly mottled subsoil of heavy clay is much less favorable for grapes.

The soil pattern that developed upon the complex lithologic base of the Chautauqua-Erie area is highly detailed, particularly in relation to the size of the average vineyard or farm.[4] Soil bodies tend to be elongated and oriented parallel to the lake shore. Differences between soils are generally maximized in a direction normal to the lake shore and to the contours which parallel the shore. In general, the three physical zones utilized in the discussion of terrain are useful for grouping and evaluating spatial patterns of soils in this area.

The soils of the escarpment zone have developed largely upon a mantle of glacial drift overlying Devonian shales. The thickness of the drift mantle varies from several feet to a few inches and is totally absent in places. The surface horizon is fairly permeable and permits a rather rapid infiltration of water, considering the rolling to steep slopes. The compact nature of the subsoil, however,

[4] H. L. Fairchild: *Glacial Waters in the Lake Erie Basin*, N. Y. State Museum Bull. No. 106, Albany, 1907; U. S. Dept. of Agric., Bur. of Soils, "Soil Survey of Chautauqua County, New York," by T. M. Morrison, et al., *Field Operations of the Bureau of Soils*, Sixteenth Report, 1914.

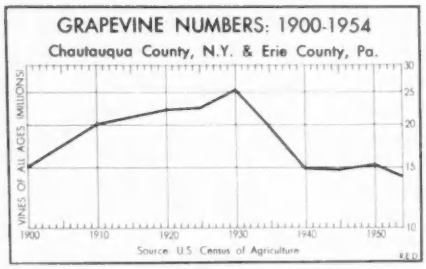


FIG. 3. Number of grapevines, 1900–1954.

retards internal drainage and strongly limits the utility of these soils.

The generally well-drained and well-aerated soils which bound the beach ridge zone on its sides are among the most favorable soils for grapevines in the area. For the most part these soils have developed upon the gravelly beach ridges of pro-glacial lakes Whittlesey and Warren. In some sections of this zone the ridges are somewhat separated and include between them soils that have developed upon the heavy textured sediments deposited in Lake Whittlesey. Elsewhere, the inter-ridge space embraces extensive coarse-textured deltaic deposits.

The soils of the lake bottom zone, developed upon the generally fine-textured sediments deposited in Lake Warren, are less favorable for grapevines than those of the beach ridge zone. The relatively flat to mildly undulating topography of this zone affords poor surface drainage. Moreover, the high degree of mottling in the subsoil reflects restricted internal drainage.

PRODUCING GRAPES IN THE CHAUTAUQUA-ERIE AREA

An analysis of the record of vineyard acreage and grape production in the Chautauqua-Erie area for the past few decades reveals several interesting characteristics of the industry. An all-time maximum grapevine population of about 25 million vines was reached about 1930 (Fig. 3). Vine numbers declined rapidly in the 1930's, diminished to about 15 million vines by 1940 and have remained approximately at that number for the past two decades. Essentially the same pattern of decline, that is, from a maximum vine population in the late 1920's or early 1930's to a smaller more stable level in the 1940's and 1950's, is repeated by other vineyard districts in the eastern and central states.[5]

Until the present decade the record of grape production in the Chautauqua-Erie area generally corresponded closely to that of grapevine numbers. Both production and numbers of vines declined markedly after about 1930 and remained at generally low levels during the 1930's and 1940's. However, the production record contrasts greatly with the number of grapevines during the decade of the 1950's when production not only returned to the pre-depression level but actually surpassed this level (compare Figs. 3 and 4). With approximately 60 per cent of the pre-depression acreage, the industry produced during the 1950's at a level more than 10,000 tons higher per year than the pre-1930 level. The marked increase in yields suggested by these comparisons calls for an examination of production methods. In the following pages the nature of the grape enterprise in the Chautauqua-Erie area will be characterized as well as the variations in production methods. The general procedures employed in establishing new vineyards will be outlined, following which, production methods will be treated in some detail under the basic divisions of dormant season activities and growing season activities.

[5] U. S. Dept. of Agric., Bur. of Agric. Econs., *Fruits and Nuts Bearing Acreage 1919–1946*, 1949, pp. 28–30.

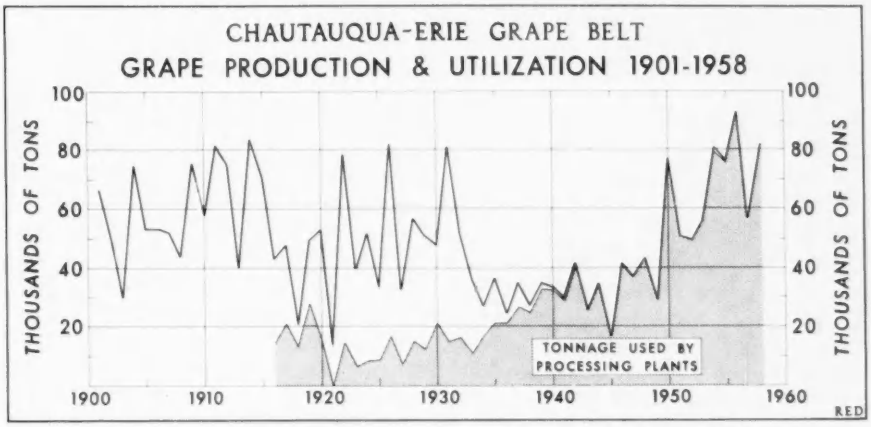


FIG. 4. Grape production and utilization in the area, 1901–1958. (Source: *The Grape Belt* [published weekly at Dunkirk, N. Y.] May 14, 1959.)

Production Methods

In terms of labor input per acre of vineyard, grape growing is a moderately intensive activity requiring an average of 125 hours per year.[6] As three or more years of labor and relatively large amounts of capital are required to establish a vineyard and bring it into commercial production, grape growing must be considered a stable, long-time enterprise.

Grape production methods appear to be quite uniform so that vineyard activities within the Chautauqua-Erie area are differentiated more clearly in terms of time than in terms of area. The activities calendar for established and bearing vineyards can be divided into two major seasons, namely, a dormant season and a growing season. Of the two seasons, the dormant season is the longer though it requires less labor, perhaps 40 per cent of the annual total. Further, it is a period during which the timeliness of operations is not normally critical. However, during the growing season, operations must be performed in a rather definite sequence the timing of which is occasionally critical.

Vineyards are essentially similar in appearance throughout the area, reflecting a rather high degree of uniformity in the methods employed in establishing vineyards. Grapevines are propagated from cuttings obtained from local nurseries and planted, generally in spring, in plowed furrows or augered holes. Vines are trained to grow on two- or three-wire trellises, four to six feet high. The umbrella system of training, which predominates in the area, is usually well established by the third or fourth season. Injured or diseased vines, or vines with crooked trunks, are renewed systematically. It has been estimated that a well-established vineyard, under good management, requires about 1 per cent annual replacement.[7]

Extending from November through April, dormant season activities are

[6] B. A. Dominick, Jr., and R. S. Smith: *Costs and Returns 22 Grape Farms Chautauqua County 1956–1957*, N. Y. State College of Agric., Cornell Univ., Dept. Agric. Econ., A. E. 1098, May, 1958, p. 13.

[7] "Nursery Reports Show New Grape Plantings Continue at High Rate," *The Grape Belt*, April 29, 1955. Published weekly at Dunkirk, N. Y.

generally flexible as to time and vary from vineyard to vineyard depending upon such conditions as weather, age of vineyard, and labor supply. These operations consist of pruning, brush pulling and disposal, trellis repair, vine renewal, tying, and fertilization.

Pruning is one of the most flexible and yet important of all vineyard operations. It is performed between fall, when the vines have matured, and spring, before the buds have begun to swell. Much of the pruning is done by professional pruners or trimmers who live in the area and who are paid premium wages for performing what is considered one of the most critical operations in the entire vineyard management program. Vines are severely pruned, generally according to a system known as "balanced pruning." Evolved over a period of years by experience and experimentation, this system has as its purpose the maintenance of a balance between fruit production and the fruiting capacity of the vine. The scale recommended for Concord vines is 30 plus 10, that is, 30 buds are left for the first pound of one-year prunings and 10 buds for each additional pound of one-year prunings. Application of this system has undoubtedly contributed in part to higher yields in recent years.

Following pruning, brush is pulled from the trellis. To an increasing extent in recent years this brush has been chopped by commercial brush choppers in the rows and left to become mixed with the surface soil. To a lesser extent today than formerly, the brush is removed from the vineyard and burned. The removal of such brush from the vineyard is facilitated by cross-alleys which provide relatively easy egress from the vineyard.

Trellises are put into good repair following pruning and brush disposal. Loose posts are pounded in, broken and badly weathered posts replaced, end-posts braced where needed, and sagging wires tightened. Vines are then retied to trellis wires before buds begin to swell in spring. Most of this work is performed by local women who are experienced in this operation.

Associated with the recent improvements in the growth and yield of Concord grapes is a sharp increase in the use of commercial fertilizers in Chautauqua-Erie vineyards and a general, over-all improvement in the total fertilization program. This enlightened program reflects clearly the creditable progress in grower education achieved largely through the efforts of experiment station and extension workers. Most grape growers now fertilize annually. Commercial fertilizers are applied generally in spring about a month before vine growth begins. Through the recognition of nutrient deficiency symptoms, the wider use of soil tests, and foliar analysis in the detection of deficiencies in elements other than nitrogen, a more intelligent and efficient fertilizer program has evolved. Though all of the above factors have contributed to improved yields, heavier applications of nitrogen have been of first-order importance. Nitrogen has been applied recently in the form of ammonium nitrate which is cheaper and requires less handling per unit of nitrogen than other carriers such as nitrate of soda or ammonium sulphate.

Organic materials are being applied to vineyards to an increasing extent. A supply of these materials is no problem for grape farmers with livestock enterprises but those without such enterprises depend upon waste products from near-by processing plants and old hay or straw. The increasing practice of chopping, rather than burning, vineyard brush reflects this trend.

Vineyard activities during the grow-

ing season represent about 60 per cent of the yearly labor input (Fig. 5). These activities consist chiefly of soil management, insect and disease control, and harvesting. Commencing about the first of May, this work normally begins with turning under the cover crop. Plowing has been replaced generally by shallow discing for this purpose. The practice of shallow discing, which avoids or minimizes root pruning, has had the effect of raising yields, especially on heavier soils where the depth of soil in which feeder roots thrive is rather limited initially. Vineyard rows are cultivated, as required, until about mid-August or September.

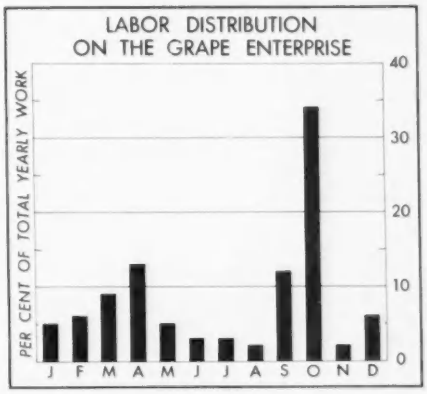


FIG. 5. Labor distribution in grape growing. (For source of data see footnote 6.)

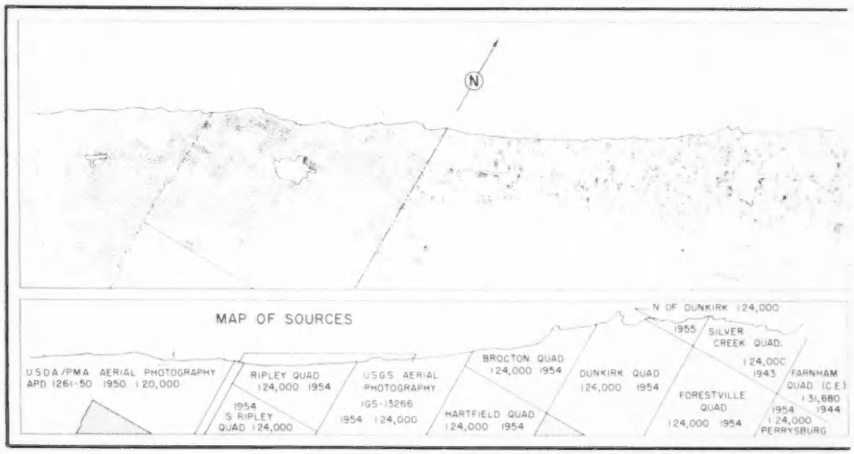
Weed growth under the trellis is more difficult to remove than that between the rows. Conventionally, such growth is controlled by cultivation with a special blade, called a grape hoe, mounted at the side of a tractor. The movement of the hoe blade can be controlled both laterally and as to depth. During the last cultivation of the season the grape hoe is used to throw a ridge of soil several inches high towards the trellis to cover weeds and sod. In early summer the same ridge is removed or thrown away from the trellis to control weeds at that time. Grape-hoeing is a slow operation which is performed carefully on both sides of the rows.

A promising alternative method of removing weeds under the trellis is the use of chemical weed sprays. Introduced in this area on a small scale about 1949, the method has increased slowly in popularity. Three carefully timed applications of weed spray are delivered by means of a specially constructed boom which straddles the trellis and sprays under the vines on both sides of a row simultaneously.

A cover crop of "overwintering" plants such as rye, domestic ryegrass, wheat, or barley is seeded, commonly at the time of last cultivation in late summer.

Growers in the Chautauqua-Erie area protect their grapes against insects and diseases by applying a minimum of two to three sprays per season. Spraying has been a more common practice in the post-World War II era of higher prices for grapes. Prior to that time there existed a most interesting areal contrast between the southwestern or Pennsylvania portion of the area and the Chautauqua County area in terms of spraying. Spraying was an accepted vineyard practice in the Pennsylvania area, where many grape growers had orchards and therefore also spray equipment, whereas orchards and spray equipment were much less common in Chautauqua County.

The most important insects and diseases affecting Concord grapes and vines in the area at the present time are the grape berry moth (*Polychrosis viteana* Clemens), grape leafhopper (*Erythroneura comes* Say), grape rootworm (*Fidia viticida* Walsh), black rot (*Guignardia bidwellii* [Ell.] Viala and Ravaz), and powdery mildew (*Uncinula necator*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SILVER CREEK QUAD. 1:24,000 1943
FARNHAM QUAD (C.E.) 1:31,680 1944
FORESTVILLE QUAD 1:24,000 1954
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FIG. 6. Distribution of grapevines in the area in the early 1950's.

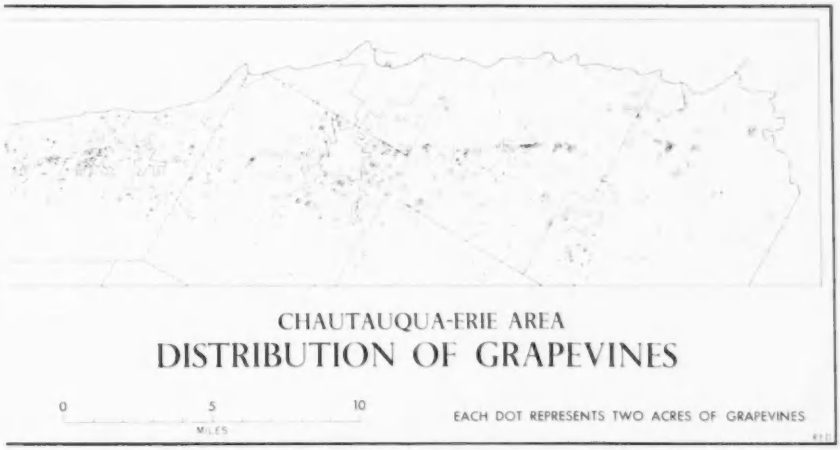
[Schw.] Burr.). Improvements in Concord grape production during the past decade have been related in no small way to the innovation of DDT in 1946. Not only was the grape berry moth brought under control as a result of DDT but also the grape leafhopper. Injury caused by the latter is more insidious than that of the berry moth. The relative absence of the grape leafhopper from Chautauqua-Erie vineyards has resulted in a more efficient functioning of leaves and better utilization of fertilizers applied.

Until recently the spray schedule utilized to keep insects and diseases under control consisted of three applications of a mixture of DDT, bordeaux mixture, and a spreader-sticker. However, in 1953 the experiment station at North East, Pennsylvania, issued a report indicating that spray schedules of bordeaux mixture alone and combination sprays of DDT and bordeaux mixture retard the yield of Concord grapes.[8] Thereafter the bordeaux schedule was replaced, for the most part, by a schedule of one ferbam spray and two sprays of low soluble copper plus lime which has proven to be effective. DDT normally is used in all applications. There followed an almost immediate and perceptible increase in vine vigor and yields as a consequence of the discontinuance of the usage of bordeaux mixture which had been the standard fungicide in the area for several decades.

As a consequence of the Miller Amendment to the Federal Food, Drug and Cosmetic Act of 1938, establishing pesticide residue tolerances, the third DDT spray of the season has been replaced by parathion, an organic phosphorous insecticide, by growers desiring premium prices for grapes destined for the several new grape products utilizing whole Concord berries.

Although spray equipment varies among grape farms, a characteristic feature of vineyard spray equipment is the inverted U-shaped hooded boom the function of which is to spray both sides of a row simultaneously. The hood, constructed of heavy canvas, was developed and introduced during the 1940's in an effort to nullify the effects

[8] James A. Cox and H. K. Fleming: *Effect of Certain Sprays on Growth and Yield of Concord Grapes*, The Penn. State Col., School of Agric., Agric. Expt. Sta., Progress Report No. 94, March, 1953, p. 6.



(Compiled from aerial photographs and topographic maps.)

of the wind which frequently interferes with spraying operations.

Grapes are harvested in late September and through most of October. The labor input during this month-long period represents perhaps 40 per cent of the annual total, varying, of course, according to the size of the crop (Fig. 5). Grapes must be fully ripe when harvested as they do not improve in color or quality after picking. The harvest is carried on by growers and their families, aided by hundreds of seasonal hired workers. In 1954, state employment offices reported that the number of domestic seasonal hired workers engaged in the Chautauqua-Erie grape harvest varied from 600 to nearly 1200.[9] In ever-increasing numbers Puerto Rican workers have been participating in the grape harvest, particularly in Chautauqua County. The bulk of the picking labor, however, is comprised of the hundreds of local women who regularly spend their fall days in the vineyards.

[9] "In-Season Farm Labor Reports" on file at Jamestown Office, N. Y. State Employment Service and at Erie Office, Bureau of Employment Security.

Distribution of Grapevines

The distribution of grapevines is shown in detail in Figure 6, compiled from aerial photographs and topographic maps. The vineyard area is nearly linear and the pattern within is patchy and discontinuous. Grapevine densities, as measured by the per cent of land in grapevines in one-mile squares, ranged as high as 52 per cent though densities above 50 per cent were restricted to a single small area in North East Township.[10] The median density for the area studied was 14 per cent and the inter-quartile range for the unit areas was from 9 to 23 per cent (Fig. 7).

A stratification of grapevine numbers by soil zones, namely, lake bottom, beach ridge, and escarpment zones, reveals density contrasts that are clearly manifested in the field. The narrow though continuous zone of beach ridges contains less than 30 per cent of the land area of the Chautauqua-Erie area. Yet in 1950 the beach ridge zone con-

[10] Densities were derived by positioning a rectangular grid, divided into one-mile squares, over the detailed work sheets utilized to compile the distribution map.

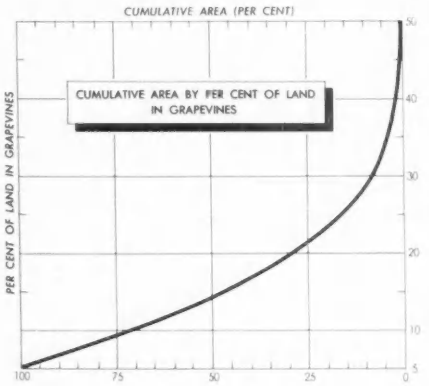


FIG. 7. Cumulative area by per cent of land in grapevines. (Data derived by planimetry of an isopleth map prepared from the work sheets used to construct Figure 6.)

tained 54 per cent of the grape acreage (Fig. 8).[11] Within this zone of generally well-drained soils, vineyards occupy 33 per cent of the land. This density varies little within the beach ridge zone where physical conditions of soil, slope, and drainage are relatively comparable throughout the area and other enterprises compete with grapes for space and labor. The maximum densities of grapevines in the entire district occur within this zone in the only section where the beach ridge zone broadens to the lake's edge, the lake being nearly 150 feet below.

Contrasting sharply with the grapevine density in the beach ridge zone is that of the lake bottom zone where the average density falls below 9 per cent. Soils over much of this zone are underlain by heavy, frequently mottled, subsoils. On such soils the grape enterprise has proven less successful than on the better drained soils. In fact a rather substantial proportion of the land in this zone lies idle.

Intermediate in density between the beach ridge and lake bottom zones is the escarpment zone where grapevines occupy nearly 15 per cent of the total area though densities contrast sharply between the Pennsylvania and Chautauqua County portions of this zone. In

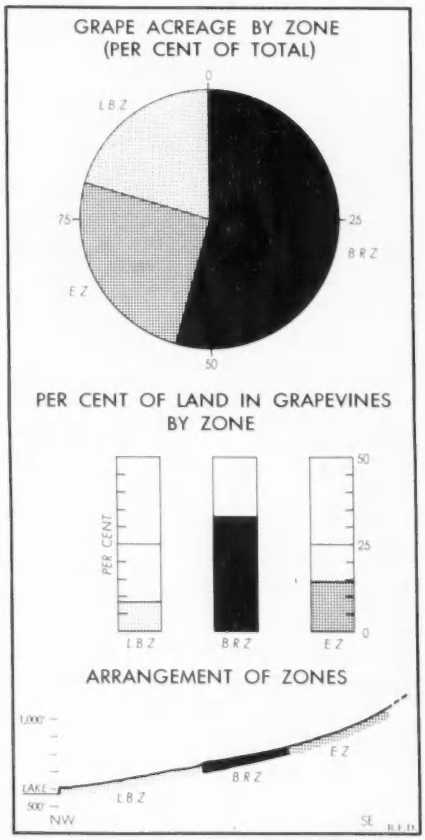


FIG. 8. Grape acreage in relation to zones. Zones are designated as follows: L.B.Z., lake bottom zone; B.R.Z., beach ridge zone; E.Z., escarpment zone.

[11] Area of the three physical zones was determined by planimetry. Zones were based upon various unpublished field sheets as well as published maps of soils and surface materials. Vineyard areas for Erie County, Pa., were derived by dot planimetry of enlargements of U. S. Depart. Agric., P. M. A. photography APD 1261–50, taken in 1950. Chautauqua County vineyard areas from: *Survey of Fruits and Vegetables in Chautauqua-Erie Area, New York, 1950, Summary Report*, N. Y. State Dept. Agric. Bur. of Statistics in cooperation with U. S. Dept. Agric., Bur. Agric. Econ., Albany, 1952.

the former area vineyards occupied 22 per cent of the land in 1950 whereas in the latter they occupied only 11 per cent.

The narrow zone of beach ridges clearly constitutes the core of the grape producing area. If this core is visualized as the "backbone" of the statistical surface depicting the density of grapevines, the importance of soils with deep, well-drained, coarse textured profiles is clear. The three peaks along this "backbone" correlate with those sections of the beach ridge zone containing unusually large accumulations of gravelly material in the form of beach bars, deltas, and terraces. Similarly, the two major saddles in this "backbone" correspond with narrower sections of the zone where gravelly accumulations are either absent or of limited extent.

Vineyard Morphology

In much the same manner as orchards, vineyards stand out in bold contrast amid fields of intertilled crops and idle land. Well-kept vineyards appear especially immaculate. The commonly rectangular or parallelogram shape of vineyards in this area relates chiefly to the similar shape of the farms. Dimensions of over 650 vineyards in the Pennsylvania section of the area were analyzed on enlarged aerial photographs.[12] Vineyard rows varied from 76 to 1400 feet in length with median lengths between 526 and 550 feet. The widths of vineyards (measured normal to the rows) varied from 26 to 1975 feet with median widths of 326 to 350 feet. Using median measures of vineyard dimensions, the length of rows exceed vineyard widths by 60 per cent.

Two characteristic features of vineyards in this area are the headlands or spaces left at the end of the vineyard rows and cross alleys which interrupt rows in long vineyards. Headlands provide room for the turning of implements and generally average 30 feet. The cross alleys at intervals of 500 to 600 feet are necessary if brush or prunings are to be removed easily.

The orientation of vineyard rows in the Pennsylvania section of the area was analyzed on the aerial photographs cited above. Vineyards were classified according to orientation and their areas measured by dot planimetry.[13] On only 38 per cent of the acreage were vineyard rows oriented more or less with the contour. The majority of vineyards had rows running more or less across the contours. In many cases this latter orientation, responsible for much of the soil erosion in Chautauqua-Erie vineyards, follows the pattern of land subdivision. On farms with long, narrow fields oriented either normal to the contours, or with the meridians, both space and efficiency would have been lost by planting the vineyard rows on the contours. Such a downslope orientation of vineyard rows has greatly frustrated the efforts of the Soil Conservation Service. On suitably shaped fields and on hillside sites the straight vineyard rows, for the most part, run approximately parallel to the contours. Many other factors such as exposure to sunlight and wind also might have influenced the orientation of vineyards.

In terms of internal arrangements of vines and trellises, vineyards are essentially similar in style throughout the area. The trellises consist of two or three wires stretched tightly one above another between sturdy wooden posts or metal stakes. The distance between vineyard rows varies from seven to

[12] U. S. Dept. Agric., Prod. and Mktg. Admin. photography APD 1261–50, 1950. Scale ca. 1:8760. Loaned to author through courtesy of S. C. S.

[13] See Walter F. Wood: "The Dot Planimeter, A New Way to Measure Map Area," *Prof. Geogr.*, Vol. 6, January, 1954, pp. 12–14.

12 feet though spacings between nine and eight feet appear to be most common.[14] Vines in a row are commonly spaced seven to nine feet apart.

Farms Producing Grapes

The farms producing grapes in the Chautauqua-Erie area, numbering perhaps 2000, are not large by American standards. Farms on the lake plain are smaller than those on the Allegheny Plateau where slopes are steeper, temperatures lower, and farming generally less intensive. Upon the lake plain the smaller farms tend to be located near Grape Belt communities, major highways, or lakeshore recreational areas. In the southwestern portion of the area, where sizes of two groups of grape farms were studied in detail, the mean size varied between 50 and 75 acres and the median between 30 and 60 acres.[15] Farms in the 80 to 90 acre class or below contained half of the grape farm acreage.

Farms producing grapes in the Chautauqua-Erie area are characterized by a comparatively simple complex of structures consisting of a house, a barn, and one or two sheds. In many cases the latter represent old grape-packing houses which stand as a reminder of the era in which grapes were packed on the farm for the table market.

Vineyard area on the average farm producing grapes varies between 10 and 20 acres and, in general, represents over one-fourth of the total farm area. Although the density of grapevines varies, the grape enterprise is relatively important in all townships of the vineyard area. At least two-thirds of the farms in over half of the nine minor civil divisions comprising the Chautauqua-Erie area reported grapevines in 1950.[16] In only two of the minor civil divisions did less than half of the farms report grapevines.

On the whole the grape enterprise is more important as a producer of farm income than as an occupier of farm area. Although the percentage of farm income derived from the grape enterprise varies among the townships of the area, in none of them does it rank below other enterprises. The grape enterprise in 1955 accounted for over 50 per cent of the total gross income on 75 per cent of the farms producing grapes, over 90 per cent on 40 per cent of the farms, and 100 per cent on 23 per cent of the farms.[17]

Grape production is associated in this area with tree fruit, small fruit, truck crop, dairy, poultry, and various other farm activities which manifest greater spatial variations, but none exhibits a pattern similar to that of the grape enterprise.

MARKETING GRAPES IN THE CHAUTAUQUA-ERIE AREA

The first century of the grape industry in the Chautauqua-Erie area, brought to a close by the 1958 grape harvest, was characterized by several market outlets. Grapes first were used commercially in local wineries centered

[14] *Survey of Fruits and Vegetables in Chautauqua-Erie Area, New York, 1950, Summary Report, op. cit.*

[15] Grape farm data compiled from the following sources: (1) Soil Conservation Service records of 104 farms producing grapes in North East and Harborcreek Townships in Erie County, Pa. 1950–1955; (2) records of ca. 290 farms producing grapes in North East Township from Erie County Assessor's Office.

[16] Data for Chautauqua County from U. S. Bur. Cen., *Seventeenth Census of the U. S.*, U. S. Census Agric.: 1950, unpub. m.c.d. data through the cooperation of the N. Y. Crop Reporting Service from Prof. M. C. Bond, Dept. Agric. Econ., Cornell Univ. Erie Co. data from U. S. Census of Agric.: 1945, unpub. m.c.d. tabulations from Region I, p. 9, Farm and Ranch Schedule, 1945.

[17] Data tabulated from a questionnaire survey conducted by the author in 1956 covering the year 1955. Nearly 1600 questionnaires were mailed; approximately 38 per cent of the questionnaires were returned.

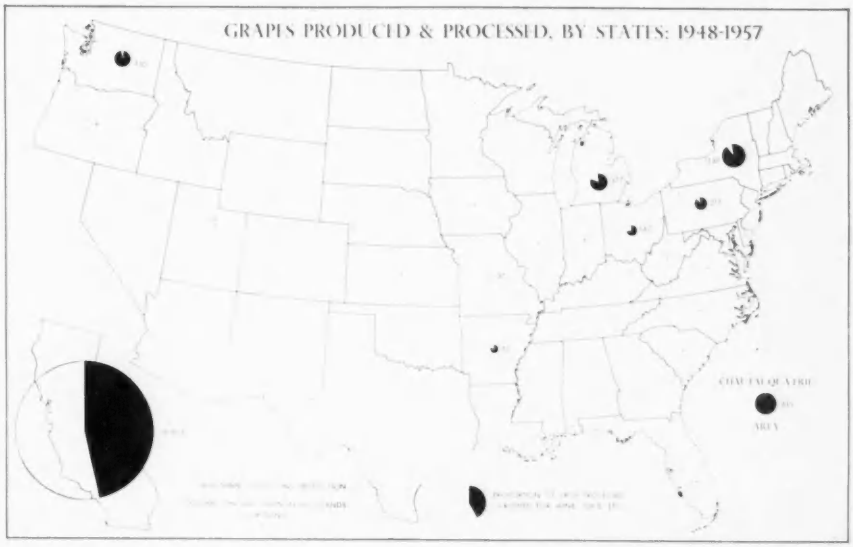


FIG. 9. Grapes produced and processed, 1948–1957. (Sources of data: *The Grape Belt*, May 14, 1959; U. S. Dept. Agric., Agric. Mktg. Ser., *Fruits Noncitrus by States, 1956 and 1957*, July, 1958; *Fruits Noncitrus by States, 1955 and 1956*, July, 1957; *Fruits Noncitrus by States, 1949–1955. Revised Estimates United States, 1934–1955*, Stat. Bull. No. 192, September, 1956; U. S. Dept. Agric., Bur. Agric. Econ., *Fruits [Noncitrus] Production, Farm Disposition, Value and Utilization of Sales, 1944–1949*. Revised Estimates, Stat. Bull. No. 114, October, 1952.)

around Brocton and North East. Later the area earned a national reputation as a producer of table grapes. These were chiefly of the Concord variety which has dominated vineyards in this area since the 1870's. The table market was supplanted gradually by a demand for bulk shipments of grapes to be used in homes chiefly for wine making. This market, which boomed during prohibition years, led to widespread plantings and to the maximum areal expression of the Chautauqua-Erie vineyard area around 1930. During this period when grapes were marketed fresh, railroads bustled with activity in the fall as Chautauqua-Erie Concords were fed to the urban markets of Pennsylvania, New York, and the New England States. The collapse of this fresh market was associated with a shift in habits of consumption, widespread overproduction of grapes, and years of depression. From the mid-1930's through the present the unfermented grape juice industry has dominated the market for Chautauqua-Erie grapes.

The growth of the Chautauqua-Erie grape juice industry is described in part by the data presented in Figure 4. This industry was launched on a commercial basis in 1897 when the Welch Grape Juice Company moved to Westfield near the center of the Chautauqua-Erie area. By 1934 the juice industry had grown in size so that it consumed over half of the annual Chautauqua-Erie crop. The proportion of the crop utilized for juice increased to over 90 per cent in 1938 and has exceeded 97 per cent in 17 of the 21 years since 1938.[18] The persistently high percentage of utilization of grapes by the juice factories is especially impressive consider-

[18] *The Grape Belt*, May 14, 1959.

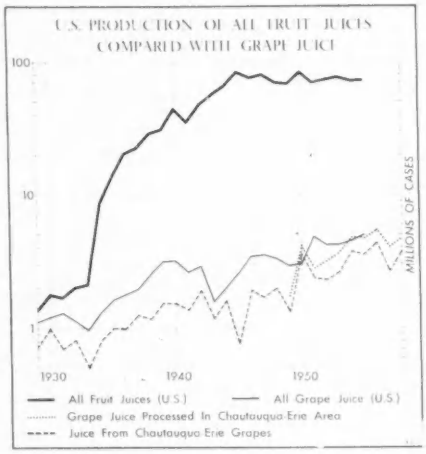


FIG. 10. Some comparisons of United States and Chautauqua-Erie area production. (Sources of data: U. S. Dept. Agric., *Agricultural Statistics 1958*, Wash., D. C., 1959, p. 199; *The Grape Belt*, issue of May 14, 1959, plus annual grape crop summaries since 1949. Data expressed in terms of cases containing 24 No. 2 cans. Tons of grapes were converted to their juice equivalent by using a conversion factor of 46.7 cases per ton of grapes processed.)

ing the marked increase in total grape production since 1949 (Fig. 4).

Grape production and utilization data by states are useful for assessing the importance of the Chautauqua-Erie industry in relation to the national grape processing industry (Fig. 9). The dominant position of California is apparent. However, the California industry is so completely different that it may be excluded from the present analysis. There remain four important states in the Great Lakes area plus Washington and Arkansas. Excluding California, the processing industry constitutes the dominant market for grapes in each of the states noted above. Among the individual grape districts represented by the state totals in Figure 9, the Chautauqua-Erie area stood in first place for the 10-year period 1948–1957, both in terms of tonnage produced and in tonnage processed.[19] Data for the Chautauqua-Erie area have been added to the map for comparative purposes.[20] Production of this area includes almost the entire Pennsylvania production in addition to over half of the production of New York State. The Chautauqua-Erie production for the 10-year period 1948–1957 is clearly greater than that of the states of Michigan, Washington, Ohio, or Arkansas.

Comparison of Chautauqua-Erie grape juice production with the total national pack of unfermented grape juice and the total pack of all fruit juices reflects some developments of interest to this analysis[21] (Fig. 10). Until 1929 grape juice was the only canned (or bottled) fruit juice on the market in quantity. After 1933 the national grape juice pack failed to retain its position in the total juice pack, largely as result of the entry of pineapple and grapefruit juices which dramatically stole the lead from grape juice. As the total national market for fruit juices expanded, other juices such as orange juice, orange-grapefruit blends, and fruit nectars entered the market, each eventually surpassing the production level of grape juice. Despite this decrease in *relative* importance, the national grape juice pack has continued to increase at least as rapidly as the population.

The above developments are corroborated by data comparing the per capita consumption for all canned fruit juices with that for grape juice for the period 1910–1954[22] (Fig. 11). These

[19] U. S. Dept. Agric., Agric. Mktg. Ser., *Fruits, Noncitrus by States, 1949–55*, Statistical Bull. No. 192, 1956, pp. 45–54; *Fruits Noncitrus by States, 1955 and 1956*, 1957; *Fruits Noncitrus by States, 1956 and 1957*, 1958.

[20] *The Grape Belt*, *op. cit.*

[21] U. S. Dept. Agric., *Agricultural Statistics* (1952), p. 252; (1953), p. 215; (1955), p. 194.

[22] U. S. Dept. Agric., Agric. Mktg. Ser., "Supplement for 1954 to Consumption of Food in the U. S. 1909–52," Agriculture Handbook, No. 62, 1955, p. 18.

data also indicate that grape juice has not only held its position during the past two decades but has made perceptible increases in the national market.

The importance of the Chautauqua-Erie production in the national market for grape juice is further suggested by a comparison of Figures 4 and 11. Variations in the production of grapes in the Chautauqua-Erie belt are reflected rather closely by variations in the per capita consumption of grape juice. That such variations in the consumption data are less evident in more recent years reflects the stability added to the market with the entry of other Concord areas into the grape juice industry. As other Concord areas entered the juice industry, the relative importance of the Chautauqua-Erie grape juice pack declined. However, the Chautauqua-Erie area has more than held its own with reference to the growth rate of the national grape juice pack. The total quantity of juice processed in the Chautauqua-Erie area includes not only the production of juice from grapes grown in the Chautauqua-Erie area but also the juice expressed from grapes brought into the area from other producing districts. During the past decade imported grapes have boosted the pack of juice processed in the Grape Belt by approximately one-third. If the pack of juice from imported grapes is added to that from Chautauqua-Erie grapes, the production of Chautauqua-Erie processing factories represents well over half and, in some years, perhaps as high as 60 to 70 per cent of the national pack.

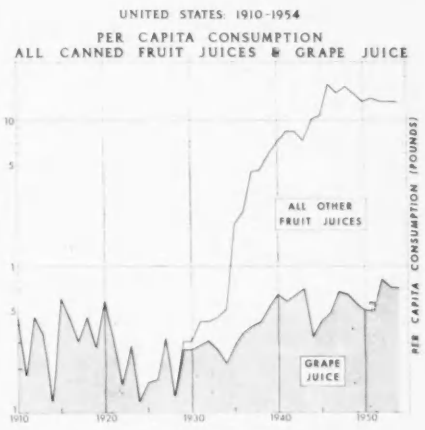


FIG. 11. A comparison of per capita consumption for all canned fruit juices with that for grape juice, 1910–1954. (Source of data: U. S. Dept. Agric., Agric. Mktg. Ser., "Supplement for 1954 to Consumption of Food in the United States, 1909–1952," *Agricultural Handbook*, No. 62, 1955, p. 18.)

Spatial Structure of the Chautauqua-Erie Grape Processing Industry

In 1955 approximately 18 factories, including two small wineries, processed grapes in the Chautauqua-Erie area. The exact number fluctuates from time to time as changes in ownership and processing occur among certain of the smaller firms. These factories receive grapes during a month-long period extending from late September through most of October. Juice is expressed from the grapes immediately upon receipt and stored under refrigeration. Though most of this juice is sold ultimately in unfermented form, an important quantity is converted into jelly and wine.

The areal expression of the Chautauqua-Erie processing industry is that of a highly dynamic nodal region with the Chautauqua-Erie belt comprising the core. The boundaries of the irregularly-shaped supply area fluctuate markedly from year to year. This areal structure, shown as Figure 12, was synthesized from annual crop summaries from *The Grape Belt* newspaper.[23] It represents an average spatial structure for the nine crop years from 1949 to 1957. The Chautauqua-Erie belt comprises the

[23] *The Grape Belt*, *op. cit.*

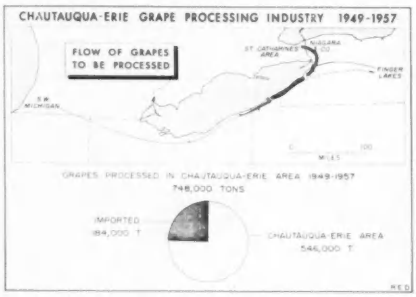


FIG. 12. The area's grape processing industry, 1949–1957. (Source of data: *The Grape Belt*, issues containing annual grape crop summaries, 1950–1958.)

core or focus of this structure. During the nine-year period three-fourths of the total tonnage of grapes processed in the Chautauqua-Erie area was supplied by the core area. The remaining one-fourth of the tonnage was imported from outside areas. Schematic flow lines depict the relative volume of movement into the belt from these various source areas. The very minor amount of Chautauqua-Erie grapes exported to the Finger Lakes wineries calls attention to the fact that 99 per cent of the Chautauqua-Erie grapes are processed locally. In some years a significant quantity of unfermented juice is shipped out of the belt in bulk to wineries in New York and Chicago to be manufactured into Kosher wines.

The movement of grapes into the Chautauqua-Erie area for processing, illustrated in Figure 12, is related obviously to the distribution of grapevines in the northeastern United States. By means of this movement, which varies considerably from season to season, surpluses from various producing districts can be utilized to maintain the operation of Chautauqua-Erie plants at an efficient level.

During the nine-year period 1949–1957 for which data are available the shipments of grapes into the Chautauqua-Erie area from the various northeastern producing districts varied greatly. The grape district on the Niagara peninsula of Ontario has frequently sent shipments of several thousand tons of Concords into the Chautauqua-Erie belt. The Niagara area centered around St. Catharines normally produces a surplus. However, the movement of these surplus grapes across the international border is impeded somewhat by a tariff barrier. A further factor inhibiting the utilization of Canadian grapes is that a few users of bulk grape juice advertise that their product is made from New York State Concords or from American Concords. The Lake Erie shore of Ohio generally ships a few thousand tons of grapes into the belt. Approximately three-fifths of this tonnage comes from the area northeast of Cleveland. In many years the Niagara County, New York, and Finger Lakes districts each ship a few thousand tons into the belt. Smaller quantities of grapes are imported from the Girard area, located in western Erie County, Pennsylvania, and from the Brant–North Collins area in western Erie County, New York. The Michigan grape crop is subject to greater variations in size than that of the Chautauqua-Erie area. Consequently, shipments of grapes to the Chautauqua-Erie area from Michigan are much more erratic than those of the areas noted above though they may amount to several thousand tons in a given year.

Within the Chautauqua-Erie area the processing factories are grouped into four nodes corresponding to the Grape Belt communities of North East, Westfield, Brocton, and Fredonia-Dunkirk (Fig. 13). With the exception of Brocton these nodes are situated at the foci of the major grapevine concentrations in the area. Brocton is situated near the northeastern end of the concentra-

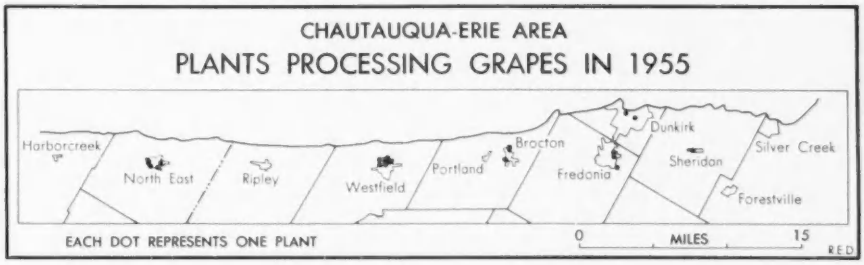


FIG. 13. Plants processing grapes in the area in 1955.

tion of vineyards centering on Westfield.

Vineyard concentrations thus correlate closely with clusters of grape processing factories which are situated in established grape belt communities where the labor supply is concentrated and the relatively large amounts of water necessary for processing is available.

Vertical Integration in the Chautauqua-Erie Grape Industry

Vertical integration has had a relatively long history in the Chautauqua-Erie area, dating back to the grape shipping associations of the 1880's.[24] Of special interest to the present analysis are the developments during the past three decades. It was not until the area lost its fresh market that cooperatives first entered the juice processing business which had been launched in this area on a commercial basis just prior to 1900 by the Welch Company. In 1929 two grower cooperative groups acquired grape processing facilities; one was located in an old wine cellar in Brocton, the other in Westfield. These cooperatives were followed by a third in 1935 and a fourth in 1938. However, the most significant development followed as a consequence of the organization of the National Grape Cooperative Association in 1945 by growers in six local cooperative groups in the Chautauqua-Erie area. That same year the controlling interest in the Welch Grape Juice Company changed hands and the new management negotiated a profit-sharing contract with the National Grape Cooperative. This contract assured the Welch Company a supply of grapes sufficient to maintain production and sales and provided that National members would receive for their grapes the price at which Welch sold its finished products to its customers, less its expense of doing business and 10 per cent of net sales to the Welch Company as its compensation.[25] In the years that followed the Welch Company modernized and expanded its processing facilities. The National Grape Cooperative also expanded as membership was extended to Concord growers in Arkansas, Missouri, and Michigan.

After an unsuccessful attempt in 1949, the National Grape Cooperative negotiated successfully a contract to purchase the Welch Company in 1952. The first attempt had failed because the Cooperative could not raise sufficient funds. The second attempt was made in 1951 and resulted in a contract to acquire the Welch Company for $15 million the following year. The contract was unusual for it enabled the Co-

[24] H. D. Phillips: *Coopera ive Marketing in the Chautauqua-Erie Grape Industry*, Cornell Univ., Agric. Expt. Sta., Memoir 28, 1919.

[25] Hall R. Clothier: *The Grape Belt*, March 27, 1956.

operative to acquire the Welch Company through the accumulation of profits from the Welch business while cash payments to growers were being maintained as under their earlier profit-sharing contract. Growers were to receive their regular advances in cash plus all of Welch's net profit in excess of 10 per cent of net sales. The entire 10 per cent of net sales, which Welch had retained under earlier profit-sharing agreements, was to be credited to members of the National Grape Cooperative in the form of 20-year non-interest bearing promissory notes. The acquisition of the Welch Company, envisaged as a 10-year operation, was completed in about half that time for in 1956 the Cooperative acquired title to the Welch Company. For additions to plants since the 1952 contract was negotiated, current assets, good will, and trademarks the Cooperative agreed to pay an additional $13.5 million. This mortgage debt was liquidated by the end of 1959.

Growers cooperatives in one way or another thus have come to control the major portion of the market outlet for grapes in the Chautauqua-Erie industry. Those groups without processing facilities have worked out profit-sharing agreements with private processors in the area. As a consequence of the foregoing developments the growers: (1) have a more secure market for grapes, (2) receive higher prices, (3) have a voice in policy decisions through their elective officers, and (4) benefit from services extending from farm to wholesale distribution channels.

The National Grape Cooperative alone has approximately 3500 members in nine states. Its nine plants have a combined processing capacity of about 110,000 tons of grapes, the equivalent of over 20 million gallons of grape juice a year.[26] The annual sales volume of Welch-National reached a high of nearly $40.5 million in 1958.[27]

SUMMARY

By reason of a propitious combination of factors of site and situation the Chautauqua-Erie vineyard area enjoys a "lacustrine climate" especially favorable for grapes of the Concord variety if a century of commercial production is any criterion. Further, the well-drained beach ridges and gravelly terraces and deltas formed in and along various pro-glacial lakes are concentrated in a continuous zone favorably situated with respect to Lake Erie and the Allegheny Escarpment.

Vineyard acreage currently stands at about 60 per cent of the all-time high of the early 1930's. That present production levels are not only equal to, but somewhat above, pre-depression levels may be attributed, in part at least, to the following factors: (1) much of the marginal acreage was eliminated during the depression, (2) spraying for insects and diseases has increased, (3) improved spray materials have been introduced, (4) a system of balanced-pruning has been inaugurated, (5) the total fertilization program has been improved and applications of nitrogen increased notably, (6) plowing between the rows has been replaced by discing so that root pruning has been minimized, and (7) growers have been educated to accept research findings and to apply them in their vineyards.

Vineyards are most concentrated in the narrow beach ridge zone where they occupy one-third of all the land. In contrast, the density of grapevines falls to about 15 per cent along the lower

[26] *1956 Annual Report*, The Welch Grape Juice Company, Inc., National Grape Cooperative Association, Inc., Westfield, N. Y., 1956.

[27] *National Grape Co-op News*, No. 31, Westfield, N. Y., December, 1958.

escarpment face and below 9 per cent in the lower or lake bottom zone. For the production area as a whole, eliminating all areas below the 5 per cent value, the density of grapevines in the median unit area was 14 per cent. The inter-quartile range for these unit areas above 5 per cent was from 9 to 23 per cent.

Perhaps 2000 farms produce grapes in the Chautauqua-Erie area. Representing about one-fourth of the total farm area the vineyard area on these farms generally varies between 10 and 20 acres. On these farms the grape enterprise was considerably more important as a producer of income than as a space occupier. Though enterprise structures vary rather widely among farms producing grapes, the grape enterprise accounted for 100 per cent of the 1955 gross farm income on nearly one-fourth of a considerable group of grape farms studied in 1956.

For the last quarter century most of the Concords of the Chautauqua-Erie area have been converted to unfermented juice by local processing plants. Launched on a commercial basis in 1897 by the Welch Company, the unfermented grape juice industry of this area today accounts for well over half of the national pack of grape juice. Approximately one-fourth of the grapes processed in the Chautauqua-Erie area are brought into the area from the various other Concord districts in the northeast. Though nearly all of the grapes are converted immediately into juice, significant quantities of juice are manufactured into jellies, soft drinks, and Kosher wines. The processing factories within the Chautauqua-Erie area are grouped into four nodes at or near the foci of the major vineyard concentrations in the area.

The vertical integration of the grape industry is of special interest. It began in the juice industry in the late 1920's and climaxed with the acquisition of the Welch Company by the National Grape Cooperative in 1956. As a result, the market area for Chautauqua-Erie Concord grape products has been extended to cover the United States more completely than ever before. Further, the market structure of the entire Concord grape industry has been strengthened greatly.

ACKNOWLEDGMENTS

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THE MILK INDUSTRY IN NORTHERN IRELAND

F. W. Boal and B. S. McAodha

Mr. Boal is a teaching fellow in the Department of Geography, University of Michigan, and Mr. McAodha is a lecturer in geography at St. Patrick's College, Dublin. Between 1956 and 1958 they worked under research grants in the Department of Geography at Queens University, Belfast, on a study of land utilization in Northern Ireland.

DAIRYING is one of the keystones of the agricultural economy of Northern Ireland. It has played such a role from a very early date, its presently highly organized state being the result of a long development.

Commercial milk production, as reflected in the sale of butter, has been a feature of the Irish economy since the Late Middle Ages. Regulations forbidding the illegal export of butter from Ireland were made in the latter part of the sixteenth century, probably to counteract the trade between Ireland and the continent in this and other livestock products.[1]

The interplay of political and economic forces implied in such regulations has been typical of conditions affecting commercial milk production in Ireland since then. The present paper describes the organization and status of milk production in Northern Ireland at the present time, and attempts to account for the features described. The points that should be emphasized are, first, the deep historic foundations of this branch of agriculture, second, the form of the production by many small farmers, third, the organizational aspects of processing and distribution, so important when a highly perishable commodity is derived from a multitude of small producers, and fourth, the important role played by the government in this whole field.

[1] J. O'Donovan: *The Economic History of Livestock in Ireland*, Cork, 1940; A. K. Longfield: *Anglo-Irish Trade in the Sixteenth Century*, London, 1929.

Historic Development

Pastoralism rather than tillage has long been the dominant element in Irish agriculture, and wealth in rural Ireland has, traditionally, been measured in terms of cattle and especially of milch cows. Archaeology and folk studies have substantiated the importance of cattle in the economy and social life of the Irish people since early Christian times at least.[2] Traditions linger on of the seasonal shift to the summer pastures in the mountains, a feature of the economy which lasted alongside the commercial marketing of dairy produce until this century.

The trade in butter developed rapidly during the eighteenth century, especially for export to Europe and the American colonies. In some areas whole estates were devoted to dairying, and a system in which the landlord let out cows to dairymen who payed their rent in butter and profits from using the by-products to rear pigs and calves was established. Such a system has indeed persisted until quite recent times in the south and

[2] E. E. Evans: *Irish Folkways*, London, 1957. Ref. Chapter 3, pp. 27–35.

southwest of Ireland. Nevertheless, it should be emphasized that it was, and is, the small producer who has contributed most to Irish dairy farming.

THE CO-OPERATIVE MOVEMENT

Production on such small farms tends to be uneven in both quantity and quality, and it was slowly realized during the second half of the nineteenth century that the only satisfactory way to compete on the world market was to develop a co-operative system to collect and market the dairy produce of the farms.

Sir Horace Plunket, Rev. Thomas Finlay, S.J., and other pioneers set about fulfilling that aim. The first genuinely co-operative creamery was established at Drumcollagher, County Limerick, in 1888. Six years later, in April 1894, The Irish Agricultural Organization Society (I.A.O.S.) was formed in Dublin, to act as a central focus for the co-operative societies. This body met with much opposition at first, particularly from the Irish Parliamentary Party which had a slight leaning towards state aid, but it gradually overcame this hostility with the result that by 1896 it was receiving a grant from the British Parliament.

In 1900 the British government established a Department of Agriculture and Technical Instruction in Dublin, with Plunket at its head. Naturally enough, this began to work in close liaison with the I.A.O.S. with the result that the latter body flourished. Difficulties were still encountered, however, the chief of these being the poor training of the creamery managers and the failure of the farmers themselves to realize the value of winter dairying as the only means of raising the value in the market of Irish butter. Despite this, the greater efficiency of the new creameries was an undoubted factor in their success. Already in March, 1899, there were 191 dairy societies in existence, as well as approximately 70 auxiliaries, with a total membership of nearly 21,000. These were concentrated in two great belts, one in the southwest of the island, centered on Limerick, the other stretching from Sligo and north Roscommon, through Leitrim, Cavan, Fermanagh, and south Tyrone, and then up the Bann lowlands. Seventy-six of the 191 societies were situated in the Province of Ulster and 63 of these in the six counties which were later to become Northern Ireland. It was these last which formed part of the basis of the dairying industry with which this paper is concerned.

The co-operative movement continued to develop slowly until World War I. After that, however, the political situation became so unstable that there were many obstacles to the effective functioning of the creameries. The outcome of the political turmoil was the establishment of two governments in the island, one in Dublin for the Irish Free State, and the other in Belfast for Northern Ireland. The political split led to the forming of the Ulster Agricultural Organization Society to take over the functions of the I.A.O.S. in so far as they had applied to the northern area.

The stage in development reached by the co-operative creameries in 1931 (in Northern Ireland) can be seen on Figure 1. The distribution is extremely significant because it helps illustrate the dual nature of dairying in Northern Ireland. It will be seen that the creameries had practically all been established in the western part of the area. This was due to two factors. Firstly, the milk market in the east is dominated by the city of Belfast and the influence of retail distributing businesses was sufficient to prevent, and indeed in

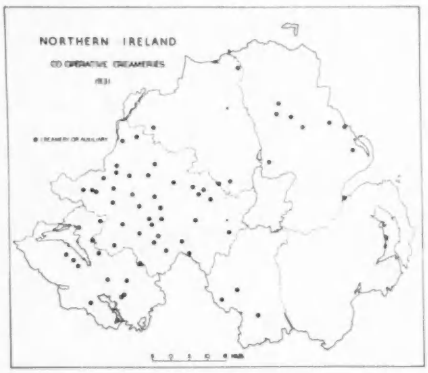

FIG. 1. Distribution of co-operative creameries in Northern Ireland in 1931. (Source: Ulster Agricultural Organization Society.)

many cases to remove, the need for co-operative organization by the farmers. Secondly, it should be noted that the co-operative movement gained its greatest strength from the Catholic farmers, and it was in consequence in predominantly Catholic areas that most of the creameries were established, though there were exceptions, particularly north of Belfast. Thus the area that served the Belfast liquid market did not develop under co-operative influence, while the other sector of Northern Irish dairying, that is the creamery areas, did. This fundamental division is still apparent, and it has been the source of many of the financial difficulties that confronted the government when the decision was made to reorganize the marketing machinery.

IMPOSED CO-OPERATION

The year 1931 saw the beginning of a new period in the structural evolution of dairying in Northern Ireland. This was marked by the rapid increase in government influence in both the output and the marketing of milk. In this year the "National" government came to power at Westminster with the avowed policy of abandoning the laissez-faire approach to agriculture, and in consequence the Import Duties Act 1932 was passed which put a duty of 10 per cent on a large class of agricultural imports. Almost at the same time the government moved into the field of marketing, for there was little to be gained by protecting agriculture behind a tariff wall if the shelter so provided was not availed of.

Being part of the United Kingdom, Northern Ireland came within the scope of the Import Duties Act, though it fell to the local parliament in Belfast to introduce an Agricultural Marketing Act of its own in 1933. This was to enable marketing schemes to be framed for any agricultural product. The first scheme was that for pigs. The next product considered was milk, but here a number of formidable difficulties were encountered. The scheme introduced in Britain put a levy on milk sold for liquid consumption, so that from the revenue thus derived equalization payments could be made to those farmers who were too remote from centers of population to find a liquid market. This was quite satisfactory, for approximately 70 per cent of the milk produced in Britain was for liquid consumption and only 30 per cent went for manufacture. In Northern Ireland, on the other hand, the position was exactly reversed due to the absence of a large demand for liquid milk, except that from Belfast itself. Thus the dairy farmers around the city would have had to subsidize about 70 per cent of the milk producers in the country, and that would have been an unbearable burden. Here we see again the dichotomy of Northern Irish dairying which previously found its expression in the creamery and non-creamery districts and which today finds expression in the problem of too much milk having to be used for low-return manufacturing purposes.

The creamery producers were receiving much less for their milk than the dairy farmers within range of Belfast, which meant those in south Antrim, north Down, and north Armagh. This price differential had not caused a marked concentration of milk production around Belfast to the exclusion of more remote areas, for in these other areas there was a long tradition of milk production mainly for making butter. Thus the economics of location were not all-powerful even on a free market. The government wished however to better the position of the creamery producers. Under the Milk and Milk Products Act 1934 all milk for sale was to be graded and that sold for liquid consumption was to bear a small levy, which was used in turn to pay a bonus to the farmers producing milk suitable for liquid consumption who could only sell it to a creamery for butter manufacture. The rest of the milk producers, being mainly those in the more remote parts, had their returns on milk increased somewhat through payments made to the creameries by the government. The actual marketing of the milk was still left in private hands, either the creameries or the large wholesalers and retailers from Belfast and the larger towns.

The outbreak of World War II in 1939 caused revolutionary changes in both the production and marketing of milk. It was recognized that milk provided a valuable home-produced food, and so, to stimulate increases in production, for the first time the government decided to pay the same price for milk of equal quality, no matter where it was produced and no matter what the final use made of it. This meant that the creamery producers found themselves on the same footing as the dairy farmers around Belfast. Every farmer in Northern Ireland now had the opportunity to produce milk under the same marketing conditions. Since milk production had previously been widespread, the removal of the price handicap under which the creamery producers had previously operated did not lead to a great increase in the numbers of producers in the creamery districts, but it did give an added encouragement to those who already had a tradition of dairy farming, while at the same time the milk producers in the Belfast area also increased production, attracted by the better prices then available. Thus milk output increased from 40.5 million gallons in 1939–1940 to 67 million gallons in 1945–1946, while the milk cattle population rose from 270,000 to 346,500 in the same period.[3]

At least from the point of view of voluntary co-operation all was not gain, however, for, though the government was willing to pay all producers the same price, in return complete control was obtained over the marketing and disposal of the milk. Under this the whole system of milk collection was reorganized and subjected to centralization. Many of the small creameries were closed; the remainder were taken over as collecting depots. The wheel had really turned full circle and yet not returned to the same position. Now, dairy farming was completely co-operative on its marketing side but the co-operation was compulsory and had its origin from above.[4] The position was one in which the location of the producer played no part (except in terms of fertility) in deciding the quantity of milk he produced, or in fact whether he was a producer at all.

Immediately after the Second World War the number of dairy farmers con-

[3] Government of Northern Ireland: *Ulster Year Book 1956*, pp. xxii-xxvi.

[4] See J. M. Mogey, *Rural Sociology*, Vol. 18, Number 3, 1953, pp. 243–248.

tinued to increase as did the volume of milk produced. Since 1949, however, there has been a steady decline in the number of producers, though the volume produced has continued to increase. Thus in 1950 there were over 25,000 producers with a production of 88.5 million gallons; in 1957 the number had dropped to 22,000 though the gallonage had increased to 106 million. The decrease in the number of those selling milk has been partly due to further government regulations, this time in regard to conditions of housing of dairy herds, which have discouraged some farmers whose farm buildings were of a low standard, though many others have made great improvements with the help of government grants. The increase in the relative favorability of beef and mutton production has also played its part.

The centralized marketing arrangements have been continued, but the organization has now been passed to the Milk Marketing Board for Northern Ireland, which was established in 1955. The Board has a membership of 13, comprised of ten producers' representatives, elected on a county and regional basis, and three nominees of the Ministry of Agriculture. The main function of the Board is to buy and sell milk. It purchases all milk produced for sale and sells it to wholesale distributors for bottling for sale to the public, or to manufacturers for processing into a variety of milk products, or to creameries for the production of butter. The Board also manufactures some of the milk itself at one of the six depots it owns and operates.[5]

GEOGRAPHICAL BACKGROUND

Northern Ireland consists basically of a central lowland basin with a series of peripheral hills and mountain groups (Fig. 2). The hilly country is broken in nature with many small interspersed plains. There is consequently a great intermingling of bare windswept upland and undulating lowland. The upland soils are generally of low productivity, being poorly developed and frequently highly acidic. The lowlands are more conducive to agriculture, with a heavy bias towards grassland, due mainly to the moist conditions that prevail through most of the year.

The lowland areas are occupied by a multitude of small farms, with a patchwork of hedged and stone-walled fields. The small size of the farms is a striking feature, 77.8 per cent of the farm holdings being under 50 acres in extent.[6]

DISTRIBUTION OF MILK PRODUCTION

Figure 3 shows the distribution of all farms on which milk was produced for sale in 1954. Their widespread nature is at once obvious. Practically all the blank areas are above the altitude where any form of farming, other than mountain sheep grazing, is feasible. However, within the lowlands there are certain areas of marked concentration. The most noticeable is a belt stretching north along the west side of Lough Neagh and then curving eastwards into mid-Antrim. Lowland Fermanagh and most of Armagh have only slightly lower densities; there is a further though less obvious concentration around the city of Belfast. In contrast northwest Londonderry and parts of Tyrone and Down have a relatively thin scatter. It should be emphasized that the map shows the farms producing milk but gives no indication of the actual volume. When Figure 4 (milk cattle) and Figure 5 (milk gallonages) are also examined it

[5] Ministry of Agriculture Northern Ireland, *Monthly Agricultural Report 32*, Number 7, November, 1957, pp 201–205.

[6] Government of Northern Ireland: *Ulster Year Book 1955*, p. 65.

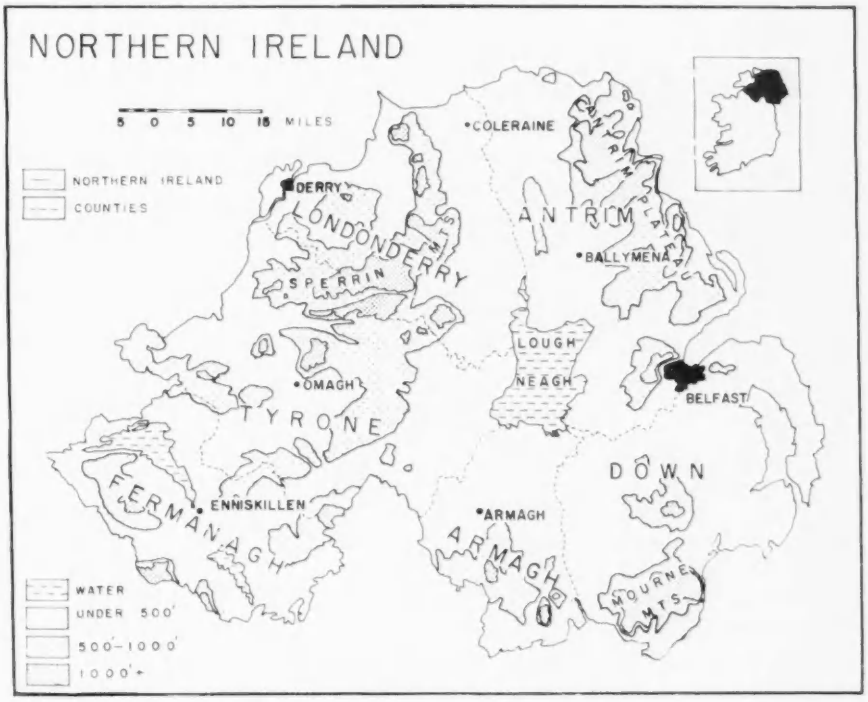

FIG. 2. Physical features, Northern Ireland.

becomes clear that there must be considerable variations in the amounts of milk produced by the farmers in different areas. In terms of actual production, the area fringing Belfast, the central part of Antrim, the northern part of Armagh, and much of Fermanagh are the leaders. This is emphasized by the location of the areas of high density of milk cattle.[7]

When we examine the three maps together it becomes clear that there are different types of milk producer. A division can be made into three such types:

(1) Specialist dairy farmers on medium to large farms (50–150 acres).

(2) General farmers who go in for milk production as part of their activities.

(3) Small farm owners (less than 30 acres) on the poorer hilly margins who keep a few cows and gain some ready cash by selling the milk.

The specialist dairy farmers can be found throughout the country but the majority are located in those areas that supply the liquid market, in particular, the population concentration around Belfast. Herds of Friesian and Ayrshire cows are most common, and intensive grassland management is an integral part of the farm program. The general farmers are much more widely scattered,

[7] Some of the high densities on the hill margins do not indicate high milk production, but are due to government economic incentives to the hill margin farmers to keep cows for stock rearing purposes.

FIG. 3. Milk license holders in Northern Ireland, 1954. (Source: Ministry of Agriculture Northern Ireland.)

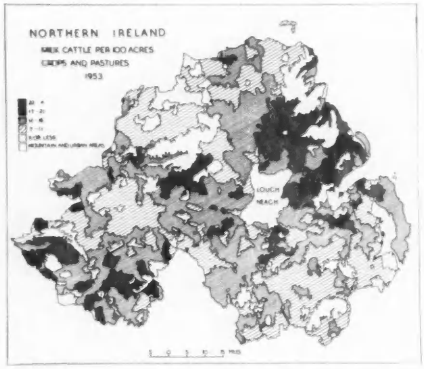

FIG. 4. Milk cattle distribution in Northern Ireland, 1953. (Source: Ministry of Agriculture Northern Ireland. Nineteen hundred fifty-three was the last year in which such data were collected on an area basis.)

FIG. 5. Milk production in Northern Ireland, June, 1958. Each circle represents the gallons collected from a Milk Marketing Board collecting route. (Source: Milk Marketing Board for Northern Ireland.)

and the breed most popular with them is the cross-Shorthorn type though the specialized dairy breeds are increasing in favor. The small farmer who sells milk is more typical of the outlying parts of the country, that is those parts away from Belfast, and in particular of the hill margins, where the main emphasis is on the rearing of feeder cattle.

FACTORS IN DISTRIBUTION

The factors underlying the pattern of distribution of milk production are extremely complex and difficult to entangle. No single overall explanation will suffice, for while it will be valid in some areas, it will break down in others. However if we look at the picture in very general terms, three main factors may be deciphered—the size of the farms; the social influence of religion, to which is related the evolution of the creamery movement; and location.

Farm size is an important factor because of the influence of available area on the type of farming to be carried out. Thus more intensive activities (in terms of return per acre) will be required on the small farms to produce adequate returns, than will be the case on the larger farms. This is illustrated by Table I. The type of farming giving the highest net return per acre is pigs and poultry (£28 per acre) followed by dairying (£26), sale crops and livestock (£25), mixed livestock (£21) and cattle feeding (£15).[8] Milk production then is an attraction for the farmer with a small or medium-sized holding. At the same time those with very large farms may well go in for less intensive enterprises such as cattle fattening. It has frequently been found that the areas of large farms (over 70 or 80 acres) are more oriented toward this activity, thus reducing the significance of dairying.

[8] *Ibid.*, p. 171.

TABLE I

OUTPUT FROM VARIOUS SIZES OF FARM NORTHERN IRELAND, 1956*

Size (acres)	*0–30*	*30–50*	*50–100*	*Over 100*
Output per acre...	£57.3	£54.5	£46.1	£37.3

*Ministry of Agriculture Northern Ireland: *Monthly Agricultural Report 32*, Number 8, October, 1957, p. 171.

The smaller farm also has the advantage with regard to milk production in the ability of the family to do all the necessary chores in connection with milking, gathering the cattle, and so on, which is not always the case with the larger units.

The use of the farm size factor to partly explain the distribution of milk production is, however, a two-edged sword, because many of the small farms are handicapped in intensifying their dairying activities through lack of capital to enable required standards of housing for the cattle to be reached.

The religious factor is particularly operative in the western part of the country. In general the Catholic farmers own smaller farms than the Protestants. Add to this the fact that Catholic families are larger, and one may conclude that the small Catholic-owned farm with plenty of family labor will find dairying more attractive than the Protestant farmer with more acres at his disposal. In addition, as we have noted above, the pre-war co-operative movement found its greatest strength in the Catholic areas and many of the present day concentrations of milk production have their origin in this development. These areas today are the principal sources of the milk that is used for manufacturing purposes.

The third factor that helps to explain the present distribution of milk production—location—was principally operative in the areas around Belfast and some of the other large population

centers. Milk production developed in these areas because of the neighboring population concentrations which were the source of a substantial demand for liquid milk supplies. Today, with truck haulage and the fact that the Milk Marketing Board charges a uniform rate for milk transportation, the locational factor is no longer significant, but its operation in the past has left a distinct imprint on the present pattern.

In sum, milk production today occurs widely, but there are local variations that can be explained by the operation of a few basic factors. The features to note are the long historic antecedents of the present dairy farming, the variations in type of producer, and the division between those producers who supply the milk manufacturing centers and those who supply the main liquid markets—the previously noted division between the liquid supply areas and the creamery areas.

MARKETING

Figure 6 shows the centers to which the milk is brought after it has been collected from the farms by trucks operating on the routes laid down by the Milk Marketing Board. The large volume going to supply the Belfast liquid market can be seen. This, together with that going to the immediately surrounding centers and to a few more outlying collecting points, comprises the great proportion of the milk for liquid consumption. The milk brought to the remaining collecting depots is almost entirely for manufacturing purposes.

With equal payments for milk now being made to all producers, the farmer need no longer have any concern in what use is made of the milk after it leaves the farm, but in fact the problems facing the marketing side of the industry are equally as formidable as those facing the farmers.

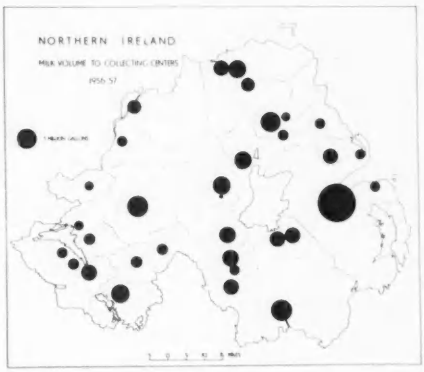

FIG. 6. Milk volume by collecting centers, 1956–1957. (Source: Milk Marketing Board for Northern Ireland.)

As far as the actual use being made of the milk, we see again the two-fold division of the country that has been the dominant thread throughout the previous discussion. The Belfast area, with a population well over half a million, is the main liquid market. Outside of this area, except for a limited number of farmers who supply the small towns, the milk goes for manufacturing. This is carried out in three kinds of establishment—a number of the old creameries now operating in close co-operation with the Milk Marketing Board, milk depots set up by the government, and a number of well-known private firms, in particular Nestle's, Fisons, and Bovril. Between them they handle all the milk that is not for liquid consumption, except for a little made into butter by the Belfast "liquid" concerns. We thus have Belfast and a few neighboring centers forming a core of liquid consumption ringed by the manufactured milk areas of the rest of Northern Ireland. The uses to which the 106 million gallons produced in a 12-month period in 1956–1957 were put can be seen from Table II.

The policy of the government is to give equal opportunities to each pro-

ducer no matter where he is located. Therefore not only do all producers receive the same price for their milk—provided it is of equal quality—but the Milk Marketing Board arranges for the collection of the milk from the farms no matter how isolated they may be, provided they are accessible by road. Figure 5 shows the differences in the volumes collected by the trucks, and also the differing intensity of routes dependent on the volume of milk produced in a given area. Many of the routes in the west collect much less milk than most of those in the east for one or both of the following reasons: (a) the producers in the west are more scattered, (b) they produce less. Thus although the Board makes a deduction of 1.7 pence per gallon for transport (1957) this is an uneconomic charge in many of the more isolated areas. But, as we have seen, such economic factors have ceased to play a part in the location and nature of milk production due to the payment made in subsidy to the producers by the government through the Milk Marketing Board.

While the subsidy may help the Board cover any transport losses, its main purpose is to enable those producers in the manufacturing areas to receive the same price for their milk as the liquid market suppliers. In 1956–1957 the subsidy payment made amounted to £4,081,260. If widespread milk production is encouraged by the removal of economic handicaps in marketing, the absence of a sufficiently large liquid market in Northern Ireland will mean that a large proportion of milk produced will have to go for manufacturing, and this will necessitate the continuance of the subsidy. A publicity campaign has been operating to get the public to "Drink More Milk" and thus increase the high return liquid consumption figures. The effect has not become clear as yet.

TABLE II

NORTHERN IRELAND MILK PRODUCTION—USE MADE OF MILK*

	Million gallons	
Milk for liquid consumption	.....	35.995
Evaporated milk	12.303	
Butter	23.683	
Milk powder	18.830	
Condensed milk	6.853	
Cheese	4.218	
Cream	2.222	
Chocolate	1.527	
Other milk products	.768	
Total milk for manufacture	.....	70.404
		106.399

*Milk Marketing Board for Northern Ireland: *Second Annual Report for the Year Ending 31st March 1957*, p. 9.

CONCLUSION

In this study we have noted the widespread nature of milk production in Northern Ireland. We have also observed that this production falls into two types, one for the liquid market and the other for manufacturing purposes. The financial disadvantages of the latter type of production have been removed by government action.

Milk production is an integral part of farming in Northern Ireland, playing a very important role not only for the specialized producers but also for those who operate dairying as part of a general farm economy.

The growth of milk production has depended on favorable physical conditions, on a deep tradition of cattle farming, and, much more recently, on the operation of carrot and stick techniques by the government. A successful future for dairy farming would appear to depend on improved use and development of the resources of stock and grass, and the continuance of government monetary assistance. If this latter factor ceased to operate many of the producers in the remoter areas might well have to turn to other sides of farming.

A problem that has now arisen is that of overproduction. The govern-

ment only makes a subsidy payment on a standard quantity which is at present set at 97 million gallons a year. Any production over this volume does not receive subsidy. The result is the subsidy that is available has to be spread over a greater volume of milk with subsequent reductions in the per gallon returns received by the farmer. Ministry of Agriculture Advisory Officers are instructing the farmers how to increase milk production by the use of better methods, but this is at present running counter to the government financial policy as administered through the Milk Marketing Board.[9]

The advantage of continued milk production in the former creamery areas is considerable not only for the farmers concerned but for all those engaged in various other parts of the milk industry —transport, butter making, milk factories, and so on. These industries are based on raw materials locally produced, and they would appear to offer a fruitful line of development for further industry in Northern Ireland, which is at present faced with a serious unemployment problem.

[9] Ministry of Agriculture Northern Ireland: *Monthly Agricultural Report 32*, Number 7, November, 1957, p. 203.

ON PERKS AND POKES*

ARTHUR H. ROBINSON

The recent and remarkable expansion of statistical research methods has clearly reached geography. Whether its eager adoption by some stems from an honest desire to get at substantive problems more efficiently, or merely from a desire to appear scientifically more respectable, is an interesting question but one hardly worth investigation. On the other hand, the fact that there has been such a development is apparently a matter of considerable moment, judging from the volume of editorials, reviews, and substantive proposals and papers that take direct and oblique looks at it. Geography seems currently to be rather strongly divided regarding the utility of quantitative research techniques; in any group to which new ideas are introduced one may observe: the *avant garde* which commits itself rapidly, wholly, and often rather thoughtlessly; the *garde arrière*, which reacts almost instinctively against change; and a larger number that, either through openness of mind or mugwumpism, adopts a watchful wait-and-see attitude.

As one might expect, the differences between the extremists in geography are in matters of degree; the most inspired of the visionaries admit, grudgingly perhaps, that some things can't be counted, and the arch-conservatives are not altogether against arithmetic. Yet the differences appear great enough to make it worthwhile to take yet another look at the causes championed by those one may call the *hyperquantifiers* as opposed to the *hypoquantifiers*, and especially at the former who represent the innovators. We have been led up the garden path before and we ought to be wary; on the other hand one ought not dismiss new ideas without an adequate hearing. In the interest of less redundancy it is appropriate to reduce the designations *hyperquantifier* and *hypoquantifier* by cancelling out their common affixial elements leaving *per* and *po* as categorical stems. These are euphonically wanting, however, and *perks* and *pokes* are far easier terms. Their connotations are a bit "loaded," but not unintentionally; the writer confesses to finding a refreshing "perkiness" among many of the more impassioned supporters of quantification and a rather depressing "pokiness" among their opposites.

Perkiness is not always a corollary of intellectual virtue, however, nor pokiness of its opposite, and it is unfortunate that both the perks and pokes imply that the rest of us ought to get at the business of choosing sides. Such choice will come to pass as a consequence of demonstrations of validity and utility. Nevertheless, in spite of the fact that the most extreme of positions is rarely tenable, it does not seem a waste of time to examine some of the implications and assertions or assumptions of the perks and pokes who seem to be at odds.

To begin with, a few observations on pokiness are in order. The time-honored and demonstrably effective methods on which the pokes would have us rely are no less rigorous and exacting than those of the perks. Denial of this suggests an ignorance of the accomplishments of the discipline. The objectives of the pokes are the same geographical ends claimed by the perks; to dispute this is to verify the ignorance. The indictment of the true poke must rest, rather, on his unwillingness to employ a particular kind of methodology that might illuminate a problem.

The descriptive and analytical usefulness

*Dr. Robinson is Professor of Geography at the University of Wisconsin. His paper is a *Guest Editorial* and continues the theme of several recent contributions to the series, but it is too long for the regular editorial page and hence is included here.

of statistical method is ably recounted in the introductions to most treatises in that field. An understanding of the potentialities of this method, and a competence in using many of its tools, is no more difficult to acquire than are most of the other specialized kind of skills and knowledge traditionally asked of professional geographical training. It is now abundantly clear that there *are* mathematical methods available for dealing with the complexity of things in spatial array for which there are no methodological substitutes. To ignore them on the basis of whim is not a minor intellectual sin of omission; it verges on "know-nothingism" at its worst. But such extremes of pokiness are rarely argued strongly, and it is the pronouncements and activities of the more aggressive and vocal proponents of perkiness that should receive our greatest attention.

If one is to have perks around one must, I suppose, learn to live with hard-to-understand, statistical jargon (although it does make professional life difficult); but one could wish they would come down to earth long enough actually to test, geographically, in simple fashion, the more basic aspects of their techniques in order to make the character of their methods abundantly clear. The majority of geographers need understandable examples and need them in good number. My main concerns with the perks, however, involve three more fundamental matters: (1) they give little consideration to some of the technical problems that are inherent in or arise from the methods they employ; (2) they imply, perhaps unconsciously, that their aims are a cut above those of pokes and others, that their work is more accurate and therefore more scientific, i.e., better, and that through their lofty *search for theory* they will immeasurably advance geographical understanding; and (3) their predilection for quantitative methods may ultimately seriously bias geographical research.

As but one example of the first, let me cite a problem to which the perks have paid little attention, namely, the significance of the inescapable regional bias that must result from the application of mathematical methods to a spatial population the areal limits of which must be arbitrarily defined—unless the whole earth be included in the study. It comes about because any geographical application of a statistical technique requires rigid boundaries around the research area. For example, if one is employing regression analysis, the coefficients obtained must necessarily be affected by the arbitrary definition of the limits of the area being studied. They are thus uniquely biased and, of course, the pattern of any subsequent residual analysis is similarly influenced. To jettison those areas that are inconveniently out-of-line with respect to the general regression is to throw out the baby with the bath water since, as unwanted "atypical" areas are discovered and deleted, the coefficients are changed and new ones will crop up elsewhere until nothing but the tiniest unique is left. "Unique" seems to be an unattractive word to perks, but I suspect that, because of the way it shows up so strongly in arithmetic results, they are going to have to learn to live with it. For them to treat an arbitrary area as a "sample" of a larger (and indeterminate) population is begging the basic question.

Again, the search for theory is a grand thing, providing there is any possibility that there is one. I suspect that the word *theory* as applied by the perks to cultural matters is used simply as a better-sounding synonym for *description*. When one is dealing with physical laws, theories are basic explanations or descriptions of their interaction that, if correct, will apply without regard to time or location. Now man certainly organizes himself in a variety of ways for a variety of complex reasons (and sometimes without reason) but he certainly is not governed by any "natural law" that is independent of himself. Furthermore, man and culture (in the broad sense) evolve continuously in a Lamarckian fashion, that is, the acquired characteristics of culture *are* inherited because society learns and passes on what it learns. Therefore, the only "natural" law of cultural spatial regularity there can be is that change will occur. Consequently, any geographical *theory* can only be a description of current or past operations. One may, of course, adopt the working assumption that "total" man might one day try to organize himself on the whole earth so as to "maximize" his "return" in a sort of materialistic, linear programming fashion, but even then his evaluation of "return" would continually change. There are an infinite number of cultural "orders" and apparent degrees of interrelationships that can be ascertained and described (by either perky or poky methods), but for a geographer to

imply that these are independent of unique culture and place is on a par with an historian claiming that "history repeats itself."

Finally, quantitative research methods are useful when a problem calls for them and the data are available. But many important geographical subjects are and *always will be* susceptible of attack only by the methods exclusively employed by the pokes. One who is not used to the often much more difficult poky methods may become fascinated by "having a jolly time with numbers" and find the practice habit forming. Only the research worker who limits his study to technique appropriately may select substantive topics that exemplify the technique being investigated. The suspicion grows, however, that some perks, who are not technical specialists, will undertake a substantive problem *only* if it can be attacked by quantitative methods. In time, as these methods appropriate to geographical research develop, and as the number of research students capable of using them grows, such a practice would inevitably lead to a serious substantive bias in geographical research. Not only would a great number of important subjects begging investigation be ignored but those actually attacked would receive only partial treatment.

I recommend that those who are concerned about these matters should keep in mind the basically simple disciplinary foundations of geography. Geography is still, as always, trying: to understand the manner in which variables exhibit locational interrelationships and functional interconnections through *area* and in *place* at the present or through time; to communicate conclusions about such understandings; and to build a fund of knowledge which will enable future geographers better to undertake the same kinds of tasks. What more could one ask of an honorable science and profession? Nothing, except to keep in mind that *place* and *area* are the passwords for entrance to it, that *all* appropriate methods to achieve its ends must be used, and that either to concentrate almost solely upon or largely to ignore any particularly specialized methodology is unacceptable on any but pedagogical grounds.

BOOK REVIEWS

The Indian Jute Belt, by P. SENGUPTA. xi and 152 pp.; maps, charts, graphs, ills., bibliogr., glossary, index. Orient Longmans Private Ltd., New Delhi, India, 1959. 9⅜ x 7 inches.

This excellent publication in the field of applied geography presents an analysis of "the physical, social, and economic background of jute-farming in India." It offers also a "study of agricultural and transport problems that arose out of the partition of the Belt" when Pakistan gained its independence. A considerable portion of the pre-partition belt, and the more productive area, went to Pakistan, giving rise to a number of difficult situations for India which had previously enjoyed virtually a world monopoly in jute.

One of the refreshing features of this investigation lies in Dr. Sengupta's practical approach to an understanding of India's relegation from a position of a producer of medium quality jute to one of low-grade quality. The author is not satisfied merely to describe and interpret the operations of the industry. After pointing out that low-grade jute is not "a paying crop" and that the consequent shift of some of the land to paddy cultivation is likely to lead to a serious jute shortage, she offers eight suggestions for the improvement of jute quality.

Although physical factors are given careful consideration in tracing the history of the development of jute production, economic elements have not been overlooked. The latter aspects give rise to some of the most serious irritations. Among them are arbitrary landlordism, burdensome taxation, corruption among the tax collectors, and excessive pressure by creditors for the repayment of loans while harvesting is in progress. The credit action forces producers to sell their crop before market prices are adequate. Labor costs are high due not so much to unit wages paid but to the primitive methods of cultivation which call for large numbers of workers. Labor accounts for some "80 to 85 per cent of the total cost." Some relief could be obtained by the introduction of quite simple equipment, better seed and site selection, consolidation of diminutive tracts into larger single farms, the use of fertilizers and improved transportation.

In spite of many handicaps to production and in the face of partition which placed in jeopardy an adequate quantity of jute for India's mills, the latter now "supply almost four-fifths" of their own requirements. This, however, has been brought about in part at the expense of other crops, more especially rice, oil seeds, and sugar cane. There is a "Grow More Jute" movement under way, but to succeed a number of conditions must be overcome first. Even so, according to the author, "there are immense possibilities for self-sufficiency in raw jute in the Indian Union without any loss of good crops."

Many charts and graphs effectively augment a convincing discussion of one of the world's important agricultural activities. More of such studies in which the author offers ideas for the solution of geographic problems would contribute greatly to the advancement of the geographic field.

EUGENE VAN CLEEF

Ohio State University

The Agrarian Origins of Modern Japan, by THOMAS C. SMITH. xi and 250 pp.; map, diagrs., index, bibliogr. Stanford University Press, Stanford, Calif., 1959. $5.00. 9 x 6 inches.

Contrary to the view held by many students of Japan, the Tokugawa Period (1603–1867) was one of important and far-reaching changes in Japanese agriculture. This is the thesis of a recent and very interesting book by Professor Thomas C. Smith. The author contends that part of the explanation of Japan's rapid modernization in the 19th and 20th centuries is to be found in the changes that took place in agriculture and village life during the two and a half centuries preceding the Meiji Restoration. While much about Japanese agriculture has changed but little over the centuries, "holdings are still tiny and fragmented, tools simple, and rice the main crop," major changes did take place, and mainly during the Tokugawa Period. "These changes, however, were of great importance for Japanese history, perhaps justifying

comparison with the agricultural revolution in Europe."

The most important change was the breakdown of cooperative farming, organized around kinship groups which shared and allocated land, labor, and capital, and its replacement by the individual family as the basic farming unit. Smith believes that the main reason for this change in the organization of production was the rapid development of industry, trade, and commerce within Japan during the Tokugawa Period. Because it was a time of relative peace and political stability, with a growing population during the first half of the Period and a rapid development of cities, there was an enormous increase in demand for food, fibers, and other products from the farm and village. The old system of self-sufficient cooperative farming, with each group producing for its own needs and each producing virtually the same crops with little or no surplus available for sale, was not able to meet these new demands. In response to the challenge of the expanding market, Japanese agriculture underwent many basic changes which the author traces from pre-Tokugawa to modern times.

Part I deals with "The Traditional Village," the organization of agriculture and rural life at the beginning of the Tokugawa Period, including an analysis of landholding systems, labor, and the organization of village political structure within the largely self-sufficient system of cooperative group farming.

In Part II, "The Village in Transition," Professor Smith traces the gradual breakdown of the traditional economic and social patterns of the village. Largely because of the vast growth of internal trade and commerce, which reached out from the cities to almost all parts of rural Japan, the old pattern of subsistence production gave way to new patterns based in large part on a competitive market-oriented system. Market demand led areas and villages to specialize in the production of those cash crops suitable to their physical environment. By the end of the Tokugawa Period many cash crops such as cotton and mulberries were rather noticeably concentrated in certain geographic areas. The change to competitive commercial farming also brought about a great increase in agricultural productivity based on major technological changes, i.e., improved seed selection, expansion of irrigation, increase in double cropping, and use of more and new fertilizers. The author is careful to point out that the changes were technological but not mechanical, and that most of the changes were a result of the spread of known techniques from one area to another. The result, however, was a very considerable increase in per-acre yields as well as increased specialization of production.

Part II also includes an analysis of the changing social system in the villages including the decline of cooperative group farming based on kinship; the increasing importance of the individual family unit; the growth of tenancy; the development of labor as an economic commodity; and the gradual weakening of the traditional patterns of cooperation and social obligations within the village. The new patterns eventually led to some increase in economic and social mobility in the village, and with it, political conflict and change as the power of the older families, based in large part on tradition and cooperative farming, was weakened.

In the last chapter Smith analyzes the importance of the changes which took place in rural Japan in relation to Japan's amazing success at modernization following the Meiji Restoration. The leaders of new Japan had the advantages of a rural population with a strong sense of the tradition of loyalty and obligation, well-disciplined and highly organized social systems and controls, and, of great importance, a population which had already experienced changes that helped to prepare them for the headlong rush into the modern world.

This book is an important contribution to our knowledge of Japan and should be of great interest to geographers, especially those who have been fascinated by Japan's singular success in the development of a modern industrial and agricultural society. While it is at times a bit difficult to determine the actual extent of the changes that took place from this study, the important thing is that changes did take place, and Japan's phenomenal success in the modern period is certainly much easier to understand when it is viewed in this context of a longer period of change and adjustment. Geographers will find chapters six and seven, about the growth of the market including the development of village industry, and agricultural technology, especially interesting as background material on modern Japan. The chapter on agricultural technology, for example, shows the typical Japanese pattern, so noticeable to anyone travelling in Japan today, of the willingness to experiment and change and the enthusiasm for new methods of cultivation and new crops. "Receptivity to the new and tolerance of the unknown and untried are particularly noticeable in the agricultural treatises which after about 1700, were ardently reformist and empirical."

The desire to improve productivity and the practical approach to technology are basic factors in Japan's greater success in agriculture than that of the other nations of Asia. These attitudes help to explain Japan's continuing progress, ever-increasing productivity, the mechanical revolution in agriculture of the post-war period, and, above all, their great success in producing so much from so little land.

ROBERT B. HALL, JR.

University of Rochester

Studies of the Central Business District and Urban Freeway Development, by EDGAR M. HORWOOD and RONALD R. BOYCE. xiii and 184 pp.; diagrs., ills., bibliogr., index. University of Washington Press, Seattle, 1959. $5.00. 10½ x 8 inches.

The central business district of the American city has attracted much research attention in recent years. Here is an addition to the growing literature on the subject. In the words of the authors, "The main objective . . . is to investigate central business structure in relation to urban freeway development."

Section I presents a methodological background. The first chapter amounts to a summary and critique of previous CBD research. The value and limitations of the Census Bureau's attempt to approximate the CBD through the use of one or more census tracts are discussed; so, too, are the potentialities of land value data in CBD research, and the work that has been done on daytime population of the CBD. In connection with daytime population it is not at all clear why the authors say, "This approach to CBD analysis is generally aimed at assessing the relative importance of a given CBD on a historical basis." There is nothing inherently historical about it.

It is with the summary of functional classification in the first chapter that I wish particularly to take issue with the authors. They discuss the CBD delimitation technique which J. E. Vance and I presented in an article in this magazine (*Economic Geography*, Vol. 30, 1954, pp. 189–222) and which they erroneously refer to as the Murphy, Vance, and Epstein technique. Horwood and Boyce say that we were concerned only with delimiting the "hard core" of the CBD whereas such an intent was nowhere stated in our article. Our technique was designed to delimit the CBD as a whole rather than its core, although admittedly no generally accepted, exact definition of the CBD has yet been advanced.

Oddly enough in view of their claim that our technique delimits only a core area, Horwood and Boyce discuss two respects in which they consider that the area we delimit is too large. They question the inclusion of parking and automobile sales as "central uses," claiming that this "can almost double the area of the central core as defined by the remaining criteria." Note, however, that we were attempting to delimit the CBD, not the CBD core; in this light these two uses do not seem at all out of place.

Secondly, Horwood and Boyce point to our failure to take account of quality differences in our delimitation, and they reason that because of this our method does not hold for very large cities without modification. When our technique was applied to Philadelphia, they say, it was found to result in the inclusion of a number of blocks of outmoded structures and thus yielded a CBD core area about twice as large as that delimited by Proudfoot in 1935 (U. S. Bureau of the Census, Census of Business, 1935: *Intra-city Business Statistics for Philadelphia, Pa.*). But here again it should be pointed out that we were not attempting to delimit the hard core. Moreover, though we were not unaware of the importance of quality it was considered that to take cognizance of this indefinite factor was beyond the possibilities of an objective reconnaissance technique such as ours.

In Chapter 2 the authors discuss what they call the CBD "core-frame concept." First, various studies are cited to prove that the CBD typically has a highly concentrated central area or core. The authors then proceed to "define" the CBD core by means of a table showing what they regard as its general properties. Next they discuss the CBD frame or zone of transition surrounding the core, and general properties are presented for this zone in a table similar to the one of CBD core properties. The primary feature of the core-frame concept, the authors say, ". . . is not so much that activities in the core and frame are distinct from each other, but rather that different functional, geographical, and historical attributes are ascribed to the core and frame, respectively." A schematic diagram is presented showing the CBD core surrounded by the CBD frame, the latter with parking and with nodes of auto sales and service (including warehousing); special services (e.g., medical); wholesaling with stocks; transportation terminals; light manufacturing; and multifamily residences. Lines of "principal goods flows" add a dynamic quality to the diagram. "Natural barriers," "heavy industry," and "residential neighborhoods" are shown as possible outer boundaries of the frame. The authors suggest that the core-frame concept may be applied, also, to outlying shopping districts or any other "aggregations of business."

These ideas make interesting reading but, at least as applied to the CBD, are nothing very new. The presence of a hard core and of a border belt, or zone, or "frame" is hardly open to argument, and flows of goods and people are admitted. But somehow, sometime, the bridge between concept and reality has to be crossed and Horwood and Boyce make no suggestion as to how their core and frame can be brought down to earth so that the CBDs of different cities can be compared. As a result, in later chapters of the book, e.g., Chapter 8, the authors have done just what so many have done in the past—they have assumed the extents of the CBDs in the various cities or perhaps followed local advice in each case. In short, they compare CBDs which have not been outlined by any standardized method and therefore are not really comparable areas.

Sections II and III use statistical techniques in analyzing data from various sources. In Section II the "two major core activities, retail sales and office use," are examined, and trends are presented as a function of city size. Section III deals in turn with measurements of decentralization in insurance offices, electrical utility offices, and banking deposits.

In Section IV, "Transportation Implications," the nature of urban freeway systems is discussed as well as problems of evaluating the impact of urban freeways on the city center. At this point if not earlier the reader may decide that he has been somewhat misled by the title of the book. Sections I, II, and III deal with CBD research, essentially unrelated to transportation; and Section IV, chiefly with urban freeway systems. The two largely distinct subjects are not woven together except in the short final chapter and then only to a limited degree.

The book is a report on research and on research possibilities. As such I feel that its most valuable contribution lies in the suggestion of various measures of CBD change that are discussed in Sections II and III and summed up in the last chapter. Thus the book as a whole lays the groundwork for research efforts designed to determine the effects of freeways on CBDs.

It would be unfair to the potential reader not to point out two adverse criticisms that apply to the book as a whole. For one thing frequent text references are made to notes that are arranged by number for each chapter at the end of the book, thus requiring endless flipping of pages back and forth. Footnotes at the bottom of each page would have made life much easier for the reader. And there is a considerable number of typographical errors as well as mistakes in references to chapters and in indexing, most of which could probably have been caught by a careful final check.

An appendix, prepared by Dr. Leonard D. Goldberg and entitled "Tax Implications," deals with the question of who should bear the costs of urban freeway developments.

RAYMOND E. MURPHY

Clark University

The Population of the United States, by DONALD J. BOGUE. xix and 873 pp.; maps, diagrs., tables, appendices, index. The Free Press, Glencoe, Ill., 1959. $17.50. 10¼ x 8¼ inches.

Donald J. Bogue's newest and largest work climaxes 11 years of intensive work on the demography of the United States during which he has added an impressive series of research articles and monographs to the basic population literature. Instead of following his original intention of updating and expanding Thompson and Whelpton's *Population Trends in the United States* through an interpretation of the results of the 1950 Census, the author decided on "the more audacious idea of analyzing and interpreting the results of the 1960 Census before it was taken, linking the changes of the 1950 to 1960 decade with the results of the intensive and varied research studies being made of the materials from the 1950 and earlier censuses." The result is a book intended primarily for reference use, a massive commentary on hundreds of statistical tables presenting data from the Census and a variety of other official sources on all the major topics that concern the population scholar.

It would be both tiresome and impractical to list the titles and major sub-headings of each of the 26 chapters, since that would be tantamount to recapitulating the entire contents of the field of demography. Suffice it to say that the chapters tend to follow a standard format: an exposition of the nature and limitations of the statistics; the genetic factors controlling the phenomenon in question; a discussion of recent change, and occasionally a retrospective look at earlier change; a description of the variations of the phenomenon within the population and its inter-relationships with other demographic factors; and, rather infrequently, a comparison with other nations. Geographers will be particularly interested in the initial five chapters which treat the size, growth, and distributional aspects of the American population; in the two chapters covering migration, both internal and international; and, possibly, in the rather brief essay on Alaska and Hawaii. The unique and valuable chapter on "Religious Affiliation," the material for which was culled from a variety of sources, will be an indispensable aid in the study of the American religious scene, for geographers and non-geographers alike, for many years to come. Judging the work solely as a reference item, the reader cannot help but be overawed at the immense labor and skill involved in collecting and arranging the tables. The book ranks high in convenience value: no other single volume contains so vast an array of information on the American population or equals its time-saving potential for the student who must dip frequently into the huge reservoir of Census facts. All this may amount to faint praise, but it is truly sincere. My only significant quibble in this respect—and this is admittedly irrelevant in a reference work—is the lack of sequential logic in the arrangement of the chapters; the discussions of the elements of population change (fertility, mortality, and migration), for example, are widely and randomly separated.

Good manners would dictate an acceptance of Bogue's magnum opus as advertised without any further ado, i.e., a handy compendium of

tables, but one well masticated for readers who are allergic to columns of figures, and ending the review at this point. But I cannot prevent myself from intoning a dirge for the book that might have been. The important series of preparatory essays, with their methodological innovations, fresh interpretative insights, and intimations of larger ideas yet to come, seemed to herald a masterly summation, the major scholarly achievement for which Bogue seems so well equipped. The result, alas, is not genuine scholarship, but simply statistical busy work; and I feel cheated not to find the mental excitement and illumination the first-rate scholar owes his public. The abundant statistical materials on our population are subjected to painstaking exegesis; but little emerges beyond their surface implications, and details are picked at to the exclusion of overall clarity and depth. The much slimmer volume by the Taeubers on *The Changing Population of the United States* (Wiley, New York, 1958) has much more to say and more neatly and elegantly, and lacks only the already wilted timeliness of the present book. Most unfortunately, the author has not really mastered the statistics; he has, instead, been snowed under by them. A case in point is the disproportionate amount of space devoted to various phases of the occupational structure of the population—more than 30 per cent of the text all told—obviously more because of the great volume of available data rather than their inherent importance.

Another major fault—this one a part of the author's basic strategy—is his complete reliance on official sources of data (except in the chapter on religious affiliation), along with his almost total avoidance of the voluminous descriptive and interpretative literature by authors outside his own research team. The pitfalls of such a procedure are painfully clear in the feeble chapter on morbidity, a subject for which governmental figures are notoriously sparse and suspicious, and the treatment of cause of death in an otherwise passable chapter on mortality. In this instance, the author could have exploited to great advantage the enormous literature by biological and social scientists on the regional, ecological, and socio-economic aspects and death and disease in the United States and introduced some highly useful comparisons with other lands and societies. The damage inflicted by Bogue's refusal to let himself wander beyond arm's length of government bulletins is less obvious but equally basic in the treatment of almost every other topic. The reader has every right to wonder whether the author is more deeply concerned with the reams of figures he has so assiduously manipulated or with the potentially rich subject which seems to be walled off dark and dead behind the unceasing tables. Possibly we are suffering from a statistical glut; some of the most provocative demographic monographs are those dealing with data-poor nations where the scholar has been driven into every possible byway for his facts and interpretation. At any rate, we—and the pronoun takes in all students of population—must still keep on waiting for a truly definitive monograph that will synthesize all the varied source materials on American population, not by rote, but with the transcendent clarity and imagination that are to be expected of the best scholarship. Because of the flat inclusiveness of Bogue's title, his otherwise well-merited prestige, and the sheer mass of the present volume, it seems unlikely that we shall have such a book in the near future.

Geographers will be particularly disappointed in this volume, if they are searching for new insights into the population geography of the United States. Bogue's previous work, with a geographic bias unusual among sociologists, may well have generated such expectations. Bogue himself would seem to be conscious of a dilemma, since he devotes the entirety of Chapter 5 to a description and a rousing apologia for his rather elaborate system of economic areas, but then almost totally ignores this system in the remainder of the text. Indeed, after the introductory chapters, the spatial element is given rather short shrift; seldom is any areal category employed beyond the Census areas and divisions, and even those gross units appear rather sparingly. It strikes a most discordant note to find a writer who has devoted so much attention to studying population redistribution urging the reader to "skip or only skim very rapidly Chapters 2 through 5, unless he is especially interested in the topic of population distribution." Except for a few Census maps, one of them the unfortunate dot map of 1950 population, the cartographic material is reproduced from earlier works by Bogue. The choice of maps to illustrate the chapter on Alaska and Hawaii is, incidentally, perhaps the worst possible. The one subject of direct geographic interest in which Bogue can be expected to excel, by virtue of his earlier accomplishments, namely internal migration in the United States, is treated rather perfunctorily. The discussion is essentially a dehydrated abstract of previous findings; nothing important has been added, and much of real interest has been stripped away. In this subject area, as in the others handled by Bogue, the geographer will find much of the basic statistical information; but in order to make fully effective use of it, he will have to apply his own analytical talents or turn to other scholars.

WILBUR ZELINSKY

Southern Illinois University

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